A star (✱) indicates that the Abstract deals with Apparatus and Instruments.

OCTOBER, 1940.

GENERAL PHYSICS.

ATOMIC AND MOLECULAR STRUCTURE.

2720. Molecular structures of dimethyl chloramine and methyl dichloramine. D. P. STEVENSON AND V. SCHOMAKER. *Am. Chem. Soc., J.*, **62,** *pp.* 1913–1916, *Aug.*, 1940.—An electron-diffraction investigation of the molecular structures of A, dimethylchloramine, and B, methyldichloramine, yields for the structural parameters of A, N–Cl = $1\cdot77 \pm 0\cdot02$ Å, C–N = $1\cdot47 \pm 0\cdot02$ Å, and C–N–Cl = $107 \pm 2°$, and B, N–Cl = $1\cdot74 \pm 0\cdot02$ Å, Cl–N–Cl = $108 \pm 2°$ and C–N–Cl = $109 \pm 2°$. In both molecules the N–Cl distance is greater than the value predicted by the covalent radius table of Pauling and Huggins, 1·69 Å. The C–N distance in dimethyl chloramine and the bond angles in both molecules are normal. AUTHORS.

2721. Packed fractionating columns and the concentration of isotopes. K. COHEN. *J. Chem. Phys.*, **8,** *pp.* 588–597, *Aug.*, 1940.—The behaviour of isothermal packed fractionating columns is deduced from their differential equation. The relation between rates of production and overall fractionation is studied, as is the rate of approach to equilibrium. The results are illustrated by problems of isotope separation. AUTHOR.

2722. Separation of isotopes by chemical means. H. C. UREY. *Washington Acad. Sci., J.*, **30,** *pp.* 277–294, *July* 15, 1940.—A history of work on separation of isotopes together with details of chemical methods. The theory of isotope separation by fractionation columns is developed and compared with experiment. Special attention is given to the separation of the isotopes of C, N and S. Methods based on exchange reactions are described in detail. It is estimated that N^{15} could be produced at a total cost of about $50/gm. For elements with $A > 40$ chemical methods become unsatisfactory, giving place to thermal diffusion methods. The latter have the advantage of requiring little attention compared with chemical methods but the cost of electricity for heating is a very large item. The use of a centrifugal fractionation column opens up possibilities for the application of chemical methods to elements of high atomic weight such as U^{235}. F. C. C.

2723. Radial distribution method in electron diffraction. J. WALTER AND J. Y. BEACH. *J. Chem. Phys.*, **8,** *pp.* 601–604, *Aug.*, 1940.—A new radial distribution function for use in interpreting the electron diffraction photographs of gas molecules has been obtained. Instead of replacing the inverted Fourier integral by a sum the integration is performed by assuming that the shapes of the maxima and minima are those of cosine functions. The amount of scattering matter $r^2D(r)$ is calculated rather than the density $D(r)$. Comparison between radial distribution functions calculated by this method and by other methods is made for a diatomic molecule, a non-linear triatomic molecule (to test resolving power), a linear triatomic molecule and carbon tetrachloride. AUTHORS.

2724. Stable relative orientation of groups connected by a C-C single bond. V. SCHOMAKER AND D. P. STEVENSON. *J. Chem. Phys.*, **8,** *pp.* 637–638, *Aug.*, 1940.

2725. Some hydrogen bridge models for globular proteins. M. L. HUGGINS. *Kodak Research Lab., Comm. No.* 762. *J. Chem. Phys.*, **8,** *pp.* 598–600, *Aug.*, 1940.—Two hypothetical types of structure, derived by folding from basic patterns containing extended zig-zag polypeptide chains, joined together by hydrogen bridges, are described and critically discussed. The (idealized, undistorted) 288-residue open-ended octahedron model has suitable horizontal dimensions but is somewhat too large vertically to fit satisfactorily into the unit cell of air-dried insulin. AUTHOR.

2726. The hydrogen bond. *Faraday Soc., Trans.*, **36,** *pp.* 871–929, *Sept.*, 1940.—A general discussion of the society to which the following papers were contributed:—W. T. Astbury: The hydrogen bond in protein structure; C. E. H. Bawn, E. L. Hirst and G. T. Young: The nature of the bonds in starch; G. B. B. M. Sutherland: The investigation of hydrogen bonds by means of infra-red absorption spectra; J. J. Fox and A. E. Martin: Infra-red absorption of the hydroxyl group in relation to inter- and intra-molecular hydrogen bonds; J. M. Robertson: The formation of intermolecular hydrogen bonds; W. R. Angus and W. K. Hill: Diamagnetism and the hydrogen bond.

2727. The polarizabilities of bonds. Part I. K. G. DENBIGH. *Faraday Soc., Trans.*, **36,** *pp.* 936–948, *Sept.*, 1940.—The refraction, or mean polarizability, of a molecule is shown to be the sum of bond refractions, or of mean bond polarizabilities, which remain almost constant, independently of the compound in which the bond is present. The bond refraction is, therefore, a bond property and is found to increase uniformly with increasing bond order. By use of data on the Kerr constant and depolarization factor the mean polarizability of a bond can be resolved into polarizabilities in directions along and at right angles to the bond. These quantities also are characteristic of the bond and the longitudinal polarizability especially is closely related to its length and order. In diatomic hydrides the longitudinal polarizability of the bond is proportional to the third power of the bond length whilst, in the case of bonds not involving H, the longitudinal polarizability is given approximately by $b_l \times 10^{25} = n^2 r^6 + 6{\cdot}0$, where n is the bond order and r its length in Ångströms. AUTHOR.

2728. Rotational magnetic moments of H_2, D_2, and HD molecules. N. F. RAMSEY, JR. *Phys. Rev.*, **58,** *pp.* 226–236, *Aug.* 1, 1940.—The radio-frequency spectra of H_2, D_2, and HD molecules have been obtained for transitions corresponding to re-orientations of the rotational angular momenta of the molecules. From these spectra the rotational magnetic moments of H_2, HD, and D_2 molecules in the first rotational states are found to be $+ 0{\cdot}8787 \pm 0{\cdot}0070$, $+ 0{\cdot}6601 \pm 0{\cdot}0050$, and $+ 0{\cdot}4406 \pm 0{\cdot}0030$ nuclear magneton, respectively, all of the moments being positive. The relative values are good to 0·2% and to this precision they are in the ratio 4 : 3 : 2 as expected theoretically. The rotational magnetic moment of H_2 in the second rotational state was found to be just twice that in the first. From the rotational moment values the h.f. contribution to the diamagnetic susceptibility of H_2 is deduced to be $(0{\cdot}093 \pm 0{\cdot}007) \times 10^{-6}$ per mole. Certain molecular interaction constants, including the interaction of the quadrupole moment of the deuteron with the inhomogeneous electric field of the molecule, are also obtained. The results are in complete agreement with similar measurements from the nuclear re-orientation spectrum. Furthermore, the dependence upon orientation of the diamagnetic susceptibility of the H_2 molecule in the first rotational state can be found. It is such that $\xi_{\pm 1} - \xi_0 = -(4\cdot 5 \pm 2\cdot 0) \times 10^{-31}$ per molecule. AUTHOR.

See also Abstracts 2736, 2737, 2772, 2856.

COLLOIDS.

2729. Constitution of colloidal silica. P. C. CARMAN. *Faraday Soc., Trans.*, **36,** *pp.* 964–973, *Sept.*, 1940.—It is assumed that, in silica, surface silicon ions tend to complete the —Si—O— tetrahedra which are the characteristic structural units of silica and silicates in both crystalline and vitreous states. As a result, a single layer of water molecules is " adsorbed " at a silica surface so strongly that the effect is to be regarded as " surface hydration," i.e. surface hydroxyl groups are formed, which have a weak tendency to dissociate, giving hydrogen ions. It is also assumed that, as crystalline silicon hydroxides are unknown, hydration of silica is purely a surface phenomenon, and that transition from massive silica to a molecule of $Si(OH)_4$ is continuous, depending entirely upon degree of subdivision. The instability of hydrated silica is also employed to explain the constant tendency to undergo irreversible condensation, so that $Si(OH)_4$ quickly changes to particles of colloidal silica, and these in turn increase slowly in size. With more concentrated reagents condensation between primary colloidal particles leads to formation of gels. In alkaline media there is a strong tendency towards the opposite reaction, i.e. destruction of —Si—O—Si— links, leading to formation of smaller particles. Applying these assumptions, it has been shown that the distinctive properties of silica sol, silica gel and sodium silicate solutions, may be simply correlated. AUTHOR.

2730. Cellulose sheet swelling. G. A. RICHTER AND K. E. GLIDDEN. *Indust. and Engin. Chem.*, **32,** *pp.* 1122–1128, *Aug.*, 1940.—The behaviour of sheeted cellulose fibres when immersed in a swelling liquid is influenced by such factors as the temperature of the solution, presence of secondary reagents distributed in the sheet or in the liquor and, to a certain extent, by a variation in the physical properties of the sheet. The effects produced are measured in terms of dimensional changes and weight increase of the drained sheet. The data show that the maximum swelling and weight increase occur at about 5°C. and that, for equivalent molar concentrations, NaOH causes greater swelling than LiOH or KOH. The presence of wetting agents which are stable in strongly alkaline solutions slightly increases swelling and absorption of solution, while addition of ethyl alcohol to the solvent in sufficient amount will repress the swelling and absorption to values comparable with those obtained when the sheets are dipped into water. AUTHORS.

2731. The electrolyte coagulation process : the influence of dilution of sol on the adsorption of precipitating ions. H. B. WEISER AND W. O. MILLIGAN. *Am. Chem. Soc., J.*, **62,** *pp.* 1924–1930, *Aug.*, 1940.—Consideration is given to the limitations of Burton and Bishop's rule and Ostwald's rule, and to the effect of dilution on the stability of sols of copper ferrocyanide, ferric oxide and arsenic trisulphide, as disclosed by a study of the adsorption of precipitating ions, e.g. the Ba-ion, during the coagulation process. The adsorption of precipitating ions at their respective precipitation values increases with dilution of sol, indicating that dilution stabilizes the sol towards all precipitating ions. The slope of the (precipitation value)/(sol concentration) curve depends upon the adsorbability of the precipitating ions, the stabilizing effect of the adsorption of ions having the same charge as the sol, and the purity of the sol. The effect of adsorption of stabilizing ions on the precipitation value is of particular importance with electrolytes that precipitate only in high concentrations; the purer the original sol the more unstable it is towards electrolytes. Burton and Bishop's rule is restated. J. K.

See also Abstract 2813.

CRYSTAL STRUCTURE AND SPECIAL PROPERTIES.

2732. Melting and crystal structure. J. W. H. OLDHAM AND A. R. UBBELOHDE. *Roy. Soc., Proc. A*, **176**, *pp.* 50–75, *Aug.* 28, 1940.—The rôle of various types of lattice flaws is discussed in their bearing on melting and crystal structure. Freezing-point determinations on lattices of a single molecule indicate the presence of such flaws in the crystals of polymethylene compounds. Freezing-point determinations on composite lattices of ketone + paraffin and ketone + ketone emphasize the importance of the rotation of the CO group for melting and indicate that lattice holes are easily formed without marked lowering of the freezing-point. Ordered composite lattices are formed when the number of holes does not exceed 12% of all the methylene groups. The results emphasize the importance of co-operative effects in lattice flaws. In the equilibrium state of a crystal such flaws might arise both from energy effects at 0°K., especially in metals, and from energy and entropy effects at higher temperatures. A picture of melting is suggested in which a network of co-operative flaws breaks up the crystal into a mosaic, or aggregate of crystalline micelles, and in which the solid-liquid transition is comparable with gel-sol transition. AUTHORS.

2733. Isomorphous replacement and superlattice structures in the plagioclase feldspars. S. H. CHAO AND W. H. TAYLOR. *Roy. Soc., Proc. A*, **176**, *pp.* 76–87, *Aug.* 28, 1940.—From X-ray oscillation and rotation photographs of a limited number of plagioclase feldspars it seems probable that the structure type depends upon the chemical composition in the following way. From pure soda feldspar to at least 22% lime feldspar there extends an isomorphous series with the albite structure, based on a unit cell with linear dimensions 8 × 13 × 7 Å approximately and containing 4 molecules of $NaAlSi_3O_8$ or the equivalent when (CaAl) replaces (NaSi). There is probably a similar range of isomorphism, near pure lime feldspar $CaAl_2Si_2O_8$, with the anorthite structure which has axes $8 \times 13 \times (2 \times 7)$ Å, but is of course very similar to the albite structure. The characteristic features of the photographs of the intermediate plagioclases can be explained, with the help of an optical model, in terms of a structure in which sheets with the albite structure and sheets with the anorthite structure alternate, but more experimental data are needed for the complete elucidation of the problem. AUTHORS.

2734. The crystal structure of rhombohedral acetamide. F. SENTI AND D. HARKER. *Am. Chem. Soc., J.*, **62**, *pp.* 2008–2019, *Aug.*, 1940.—The crystal structure of acetamide is determined. Its space group is C_{3v}^6—R3c; $a_0 = 11{\cdot}44 \pm 0{\cdot}03$ Å, $c_0 = 13{\cdot}49 \pm 0{\cdot}03$ Å referred to the smallest hexagonal unit cell which contains 18 molecules of CH_3CONH_2. The structure leads to the conclusions (*a*) that the length of the N–H–O bridge is $2{\cdot}86 \pm 0{\cdot}05$ Å, (*b*) the molecule of acetamide is planar, (*c*) the molecule exists in the keto form, and (*d*) the N–H bonds lie in the plane of the molecule. The intramolecular distances are $C–CH_3 = 1{\cdot}51 \pm 0{\cdot}05$ Å, $C–NH_2 = 1{\cdot}38 \pm 0{\cdot}05$ Å, $C–O = 1{\cdot}28 \pm 0{\cdot}05$ Å, and the bond angles are $CH_3–C–NH_2 = 109 \pm 5°$, $CH_3–C–O = 129 \pm 5°$, and $NH_2–C–O = 122 \pm 5°$. AUTHORS.

2735. Determination of the devitrification temperatures of glasses. E. PRESTON. *Soc. Glass Technol., J.*, **24,** *pp.* 101–108, *June*, 1940.—A modified gradient method of devitrification temperature determination is described and results from it are compared with those previously obtained by workers employing the classical quenching method. The method is shown to be reliable and capable of giving information at the same time on the rate of crystal growth at temperatures throughout the devitrification range. Examples of errors due to non-establishment of equilibrium, and surface devitrification brought about by volatilization of one or more of the glass constituents, are described. AUTHOR.

See also Abstracts 2729, 2745, 2812, 2846.

DIFFUSION AND OSMOSIS.

2736. Thermal diffusion separation of radioactive and ordinary hydrogen isotopes. G. T. SEABORG, A. C. WAHL AND J. W. KENNEDY. *J. Chem. Phys.*, **8,** *pp.* 639–640, *Aug.*, 1940.

2737. Theory of the thermal diffusion coefficient for isotopes. R. C. JONES. *Phys. Rev.*, **58,** *pp.* 111–122, *July* 15, 1940.—Enskog's general theory of thermal diffusion holds for a gas of spherically symmetrical molecules which is sufficiently dilute that collisions of more than 2 molecules at a time are of negligible importance. The first approximation to the thermal diffusion constant of a mixture of 2 isotopes is derived from this theory. The result is presented in terms of suitably defined cross-section integrals, in which the intermolecular forces are not yet specialized. This general formula for the thermal diffusion constant a is then worked out explicitly for several well known molecular models: the elastic sphere model, the inverse power model, the Sutherland model and the Lennard-Jones model. The various limitations on the accuracy of the theory are discussed, and the theoretical results are compared with the few experimental data which are as yet available. Customary molecular models of kinetic theory are hardly adequate to give a satisfactory account of thermal diffusion. The best check is obtained for Ne with the Sutherland model. AUTHOR.

ELASTICITY AND PLASTICITY.

2738. Castigliano's principle of minimum strain-energy, and the conditions of compatibility for strain. R. V. SOUTHWELL. *Phil. Mag.*, **30,** *pp.* 252–258, *Sept.*, 1940.—In an earlier paper [Abstract 1973 (1936), of the 6 equations of compatibility 3 were deduced with the use of Maxwell's stress functions, the other 3 with the use of those of Morera, appeal being made in each instance to Castigliano's principle of minimum total strain-energy. A paradox is thus presented, in that it would appear that 3 of the 6 equations are redundant. This paradox is examined in the present paper. It is shown that all 6 equations are in fact necessary conditions of compatibility, and that the stress functions either of Maxwell or Morera do in fact constitute the most general solution of the stress-equations of equilibrium. The paradox is resolved by showing that more might have been proved in the earlier paper; when account is taken of the restrictions imposed by the conditions of equilibrium at the boundary, all 6 of the equations of compatibility can be deduced as a consequence of Castigliano's principle. AUTHOR.

2739. General bi-harmonic analysis for a plate containing circular holes. A. E. GREEN. *Roy. Soc., Proc. A*, **176,** *pp.* 121–138, *Aug.* 28, 1940.—A general solution is given for problems of generalized plane stress distributions in an infinite plate which contains circular holes of varying sizes in any positions, subject only to certain conditions of convergence of the solution. The method for extending the results to allow for the effect of one or two straight boundaries is indicated. As a particular case of the general solution the problem of the stress distribution in an infinite plate under tension containing 3 holes in a row is discussed and a few numerical results are given. These results are compared with experiments which were carried out by P. L. Capper. The comparison is incomplete as the experiments were done for a finite plate and the influence of the edges of the plate on the numerical values of the stresses is considerable. Agreement, however, is found for the general character of some of the stresses.

AUTHOR.

2740. Initial stage of plastic deformation in lead under compression. W. J. LYONS. *J. of Applied Physics*, **11,** *pp.* 514–521, *Aug.*, 1940.—In the steady-creep stage in metals stress (or resistance to deformation) is related to the velocity of deformation in accordance with the hyperbolic-sine law or the exponential law. These laws, however, fail completely to describe the initial stage of plastic deformation in Pb. The present series of tests is an investigation of this initial stage in compression. An optical lever system and high-speed cymograph have been employed. The photographic records obtained show the progress of deformation with time. The duration of the initial stage increases with the compressing load. For a load of 120·0 kg. the duration is about 0·16 sec. It is found that a unique initial deformation, independent of time, is associated with each load. From measurements on the deformation curves resistances as functions of time have been calculated. These data indicate a linear relationship between the resistance R and time t: $R = l + mt$, where l = a parameter of small value, evidently a correction term, and m = rate of increase of resistance. Using this equation and the dynamic constants of the apparatus, deformation curves in good agreement with experiment have been derived. Resistance in the initial stage appears to be only approximately a function of deformation alone. AUTHOR.

2741. Measurement of strain in glass. J. G. HOLMES. *Journ. Sci. Instruments*, **17,** *pp.* 227–228, *Sept.*, 1940.—The stress distribution in a rectangular strip of glass subject to a uniform bending moment gives a similar appearance when viewed in polarized light to that given by quartz wedges, and it may therefore be used to evaluate the unknown stresses in strained optical media. AUTHOR.

2742. Influence of initial stress on elastic waves. M. A. BIOT. *J. of Applied Physics*, **11,** *pp.* 522–528, *Aug.*, 1940.—A rigorous treatment is given of the problem of wave propagation in an elastic continuum when the influence of the initial stress is taken into account. After a short review of the theory various cases of initial stress are considered. It is shown that a uniform hydrostatic pressure does not change the laws of propagation. A hydrostatic pressure gradient produces a buoyancy effect which causes coupling between rotational and dilatational waves. Bromwich's equations for the effect of gravity on Rayleigh waves are

derived from the general theory and the physical transition from Rayleigh waves in a very rigid medium to pure gravity waves in a liquid is discussed. The case of the vertical uniform stress is also considered and it is shown that the effect of the initial stress on the waves in this case cannot be accounted for by elastic anisotropy alone. Reflections may be produced by a discontinuity in stress without discontinuity of elastic properties.
AUTHOR.

2743. Effect of speed of pulling jaws on the tensile strength and stretch of leather. R. B. HOBBS. *Bureau of Standards, J. of Research,* **25,** *pp.* 207–214, *Aug.,* 1940.—1 900 measurements of strength and stretch were made at 6 different jaw speeds, using a horizontal Scott machine of 800 lb. capacity. The tensile strength increased with jaw speed, the rate of increase being least between 6 and 12 in./min. The change in stretch with jaw speed was erratic; the average difference between the stretch at 0·5 in./min. and that at 20 in./min. was 1%, or no greater than the smallest interval of stretch measured. AUTHOR.

See also Abstracts 2832, 2838.

LENGTH, AREA AND VOLUME.

***2744. Micro-analysis of gases by physical methods.** C. E. RANSLEY. *G.E.C. J.,* **11,** *pp.* 135–141, *Aug.,* 1940.—The author reviews the methods available for the quantitative analysis of very small volumes of gas and describes an apparatus for the micro-analysis of gas mixtures at low pressures, in which physical tests are used as far as possible for identification of the various gases. In certain analytical operations the l.p. method possesses definite advantages over ordinary chemical procedure. The experimental details of the determination of C and O in metals and of an analysis of a mixture of H_2, O_2, CO, CO_2, N_2 and A, are described. The paper is well illustrated with diagrams. H. H. Ho.

MATHEMATICAL METHODS AND THEORY OF MEASUREMENTS.

2745. Graphical method for selecting suitable targets for precision determination of cubic lattice constants and for solving cubic powder patterns. L. A. CARAPELLA. *J. of Applied Physics,* **11,** *pp.* 510–514, *Aug.,* 1940.—Graphical charts from which the angles of diffraction lines may be obtained as a function of lattice constant and radiation have been prepared for cubic powder patterns. The charts are especially useful in predicting positions of back-reflection lines in order that suitable targets for precision determinations of lattice constants may be chosen. Moreover, cubic powder patterns may be quickly indexed, β-lines identified, and lattice constants read to better than 1%. No calculations are necessary after the angles of diffraction have been measured. AUTHOR.

***2746. Square root extractor.** H. D. GREEN. *Rev. Sci. Instruments,* **11,** *pp.* 262–264, *Aug.,* 1940.—A mechanical device is described for extracting a root or obtaining a power of successive ordinate values of curves. It is particularly useful in calculating the total volume flow in a pulsating stream from velocity (or rate of flow) records obtained from venturimeters, orifice meters or Pitot tube meters, in which the deflection of the record is usually proportional to the square of the flow, and with hot-wire meters and thermostromuhrs in which the deflection of the record is proportional usually to the square root of the rate of flow.
AUTHOR.

MECHANICS, QUANTUM.

2747. Spinor equations for particles with arbitrary spin and rest mass zero. J. S. de Wet. *Phys. Rev.*, **58,** *pp.* 236–242, *Aug.* 1, 1940.—The spinor equations for arbitrary spin and rest mass zero are examined in some detail. Fierz has shown that for all values of the spin $f > \frac{1}{2}$ there exists only 2 " really " independent plane-wave solutions instead of $(2f + 1)$ when the rest mass is not zero. Fierz later showed that these 2 plane waves correspond to components of spin $\pm f$ along the momentum vector of the wave. This is obtained in a simpler and more direct way. Author.

2748. Energy levels of a rotating vibrator. I. Sandeman. *Roy. Soc. Edinburgh, Proc.*, **60,** 2, *pp.* 210–223, 1940.—The theoretical work of Dunham [Abstracts 4812 and 4813 (1932)], based on the rotating vibrator for the diatomic molecule, has been simplified and extended, the calculations of the molecular constants from spectral data having been rendered simpler and more rapid by the adoption of a different set of constants in the potential function. The form of the potential function adopted by Dunham is discussed and compared with that used by various other workers. Dunham's analysis is rounded off by the addition of further vibrational and vibrational-rotational coefficients. G. O. B.

2749. Statistical mechanics of co-operative phenomena. J. G. Kirkwood. *J. Chem. Phys.*, **8,** *pp.* 623–627, *Aug.*, 1940.—A direct method of successive approximation to the configuration partition function, based on the use of local free energies, is described. The method serves to clarify the assumptions underlying the Bethe method of local configurations and the quasi-chemical method of Guggenheim and Fowler. Author.

See also Abstract 2847.

PHILOSOPHY OF SCIENTIFIC METHOD.

2750. Measurement of the rheological properties of some industrial materials. G. W. S. Blair. *Journ. Sci. Instruments*, **17,** *pp.* 169–177, *July*, 1940.—The problem is discussed of selecting apparatus and technique suitable for testing materials hitherto judged by subjective means. A representative classification of 24 methods or types of lists is given, and a table is constructed giving figures for 8 factors of rheological importance as obtained by various indicated methods for about 30 industrial materials. It is suggested that a " rheological formula " be worked out from the results of approximate measurements, and that this be compared with a table (such as that referred to above) in order to find out what types of tests have already been successfully applied to rheologically similar materials. The dimensional characteristics of original methods should be carefully watched. In cases where the subjective judgments of experts are important, a quantitative measurement of the reproducibility of such judgments is very desirable, as well as the correlation between these judgments and the results of objective tests. N. M. B.

PRESSURE.

***2751. Ionization gauge circuit.** R. M. Bowie. *Rev. Sci. Instruments*, **11,** *pp.* 265–267, *Aug.*, 1940.—Recently an article has appeared [Abstract 1729 (1940)] describing a new style ionization gauge. The ionization gauge circuit which is here described was designed for use with it and combines the advantages of high sensitivity, stability, and ruggedness required for industrial use. These advantages are achieved through the use of a balanced amplifier, negative feed-back and gas tube voltage regulation. AUTHOR.

SOLUTION.

2752. Aqueous solubilities of some aliphatic ketones. P. M. GINNINGS, D. PLONK AND E. CARTER. *Am. Chem. Soc., J.*, **62,** *pp.* 1923–1924, *Aug.*, 1940.—Aqueous solubilities of 12 aliphatic ketones have been determined for 20, 25 and 30°. Low molecular weights and low temperatures result in large solubilities. The most compact isomers tend to be most soluble but movement of the carbonyl group toward the centre of the molecule tends to reduce the aqueous solubility. AUTHORS.

2753. Researches on asphaltenes. Part I. F. J. NELLENSTEYN AND J. P. KUIPERS. *J. Inst. Petroleum,* **26,** *pp.* 401–406, *Aug.*, 1940.—The difference in solubility of asphaltic bitumen in solvents having the same surface tension (ether and petroleum spirit) is explained. The solubility curves of asphaltic bitumen from Trinidad-Lake asphalt and the separation of light-coloured compounds in the ether extract of this bitumen prove that incomplete miscibility of the oily medium and the protective bodies of asphaltic bitumens with petroleum spirit enters into action. The ether-soluble, petroleum-spirit-insoluble compounds appear to be present in almost all asphaltic bitumens. Their rôle in the asphaltic bitumen system has not yet been cleared up; they should probably be considered as belonging partly to the oil medium, partly to the protective bodies. Ethyl ether should be preferred to normal gasoline for the asphaltene determination. The practical advantages of ether for the determination of asphaltenes have previously been pointed out. It appears, however, that also from a theoretical point of view ether should be used instead of the usually employed normal gasoline. The ether asphaltenes in the majority of cases are pure flocculates, whilst the petroleum-spirit precipitates of asphaltic bitumen are mixtures of a flocculate with a de-mixing precipitate. The presence of highly oxygenated bodies in Trinidad-Lake asphalt could be proved by extraction of the difference-asphaltenes with acetone. AUTHORS.

SURFACE PROPERTIES.

***2754. Heats of adsorption of gases on iron synthetic ammonia catalysts at low temperatures.** R. A. BEEBE AND N. P. STEVENS. *Am. Chem. Soc., J.*, **62,** *pp.* 2134–2140, *Aug.*, 1940.—The differential heats of adsorption of a number of gases have been measured in the temperature region 0 to −183° using a doubly promoted iron catalyst and a pure iron catalyst. The heat measurements indicate that the adsorption of N and of A at −183° is exclusively of the van der Waals type; that the adsorption of H at −183°, and of CO at −183, −78 and 0° is in part chemisorption; and that CO_2 is chemisorbed on the alkali promoted catalyst at −78° although the adsorption of this gas on the pure iron catalyst is exclusively van der Waals. The heat evolved in the irreversible adsorption of O at −183° approaches, in order of magnitude, that of iron oxide formation; and the form of the time-temperature curves with O at −183° indicates that the adsorption process involved is complex. A similar complex process was previously observed with chromic oxide gel at −183°. AUTHORS.

2755. Adsorptive properties and determination of the specific surface of lead chromate. I. M. Kolthoff and F. T. Eggertsen. *Am. Chem. Soc., J.*, **62,** *pp.* 2125–2131, *Aug.*, 1940.—Procedures are described for the determination of the specific surface of fresh and aged precipitates of lead chromate by means of the wool violet and thorium B methods. In studying the exchange between radioactive lead and inactive lead on the surface of lead chromate in an alcoholic medium it was found that lead acetate was strongly adsorbed on the surface of lead chromate. This led to the development of a simple new method for the determination of the specific surface of lead chromate. Authors.

2756. Surface tensions of aqueous solutions of polyoxyethylene glycols. E. L. Lovell and H. Hibbert. *Am. Chem. Soc., J.*, **62,** *pp.* 2144–2148, *Aug.*, 1940.—The surface tensions of aqueous solutions of a number of unipolymeric oxyethylene glycols (with 3, 6, 18, 42, 90 and 186 repeating units, respectively) have been measured at various concentrations. For the higher members the surface tension lowering is a linear function of the logarithm concentration. The results have been compared with the known behaviour of short-chain polymethylene compounds and some molecular areas calculated from Gibbs' adsorption isotherm. Authors.

2757. Monolayers of some esters and chlorinated derivatives possibly useful as lubricating addition agents. G. L. Clark and J. V. Robinson. *Am. Chem. Soc., J.*, **62,** *pp.* 1949–1951, *Aug.*, 1940.—With an improved film balance under carefully controlled conditions measurements are made of area per molecule and collapse pressure on water surfaces for monolayers of certain esters which have possible use as addition agents in lubricating oils, namely methyl stearate, α-chlorostearate, dichlorostearate, oleate, ricinoleate and chlororicinoleate, ethylene glycol distearate and ricinoleate and tricresyl phosphate. The addition of hypochlorous acid to the double bonds of methyl oleate and ricinoleate was studied by spreading monolayers on an aqueous solution of chlorine in the film balance trough. Films are built up by the Blodgett-Langmuir technique. Only methyl stearate and ethylene glycol distearate formed solid condensed films which could be picked up in any number of monolayers and subjected to X-ray diffraction analysis. The remaining esters formed " liquid " films from which only 2 to 5 monolayers could be picked up for electron diffraction analysis. Authors.

See also Abstract 2814.

TIME.

See Abstract 2758.

VISCOSITY AND FRICTION.

***2758. Accurate timing equipment for viscosity determinations.** E. M. Fry, Jr., and E. L. Baldeschwieler. *Indust. and Engin. Chem. (Analytical Edition)*, **12,** *pp.* 472–473, *Aug.* 15, 1940.—A method and apparatus for obtaining accurate timing for short intervals are described. The accuracy is better than ± 0·1% on intervals of 100 sec. and over. Authors.

2759. Relation between concentration and viscosity of polyoxyethylene glycols. E. L. Lovell and H. Hibbert. *Am. Chem. Soc., J.*, **62,** *pp.* 2140–2143, *Aug.*, 1940.—The viscosities of 42- and 90-membered oxyethylene glycols, and the 42-membered dichloride, have been measured at 20° over the concentration range 1 to 4·5%. Solutions of the 186-membered glycol in carbon tetrachloride have been similarly investigated over the concentration range 2 to 10%. In the region of dilute solutions (below 5%) a linear relationship is found between the specific viscosity and concentration (gm./l). The data at all concentrations are in accordance with the Arrhenius equation. When any 2 members of the series are mixed with one another, the resultant specific viscosity is the sum of the specific viscosities of the individual components. The polyoxyethylene chain appears to be highly convoluted in solution, being unlike the polymethylene chain in this respect. AUTHORS.

***2760. Kinematic viscometer for liquid asphaltic products.** A. P. ANDERSON, K. A. WRIGHT AND R. L. GRIFFIN. *Indust. and Engin. Chem.* (*Analytical Edition*), **12,** *pp.* 466–468, *Aug.* 15, 1940.—A new type of kinematic viscometer has been developed for measuring viscosities in centistokes of the whole range of commercial asphaltic liquid road materials at a single temperature. It incorporates features in design to facilitate the operations of filling, adjustment of hydrostatic head, and cleaning. Three capillaries of decreasing bore diameters arranged in series with intervening bulbs permit measurements of viscosities over an extended range without changing capillaries or pressures, as is necessary in other types of instruments. AUTHORS.

ASTRONOMY AND ASTROPHYSICS.

COMETS AND METEORS.

2761. Two new constituents of meteoritic gases. J. D. BUDDHUE. *Am. J. Sci.*, **238,** *pp.* 569–572, *Aug.*, 1940.—Since there is reason to believe that there is some connection between meteorites and comets, and the spectra of comets' heads show that CN is present, a search was made for CN in the gases evolved by heating stone meteorites in a vacuum. A spectrographic method was used. In addition to He, oxides of C, N, H and possibly the C_2 molecule, CN was found and also Ne. CN has not previously been reported and Ne has been found only in moldavites. Although looked for, A could not be found. AUTHOR.

COSMOGONY.

2762. On cosmic particles. T. TAKEUTI. *Phys. Math. Soc., Japan, Proc.*, **22,** *pp.* 325–327, *April,* 1940.—The existence of cosmic clouds is related to the change of mass of the sun, and to Miller's ether drift experiments. Secular change in the velocity of light is attributed to a variation of the distribution of matter round the earth during its passage through the cloud. C. B. A.

DYNAMICAL PROBLEMS (ASTRONOMICAL).

2763. Sine relation and minimum ellipticity in Foucault pendulums with copper suspensions. B. DASANNACHARYA AND B. S. GAUTOM. *Phil. Mag.*, **30,** *pp.* 151–160, *Aug.*, 1940.—The authors examine the sine relation which gives the ellipticity developed by a Foucault pendulum as a function of the time interval from releasing the bob and of the initial direction of oscillation. The relation is found to be valid for copper suspensions of about 0·3 mm. diameter and of length from 250 to 15 cm. The amplitude of the sine term cannot be reduced to zero; its value varies with the length of the suspension. The lower limit to which it can be pushed varies inversely as the square of the length, if the initial angular amplitude is kept constant at 1/20 for all lengths. By analogy with a cantilever the authors suggest that the performance of a pendulum as regards ellipticity should correlate with Young's modulus of the material of the suspension and with the dimensions of the wire. A. Hu.

PLANETS.

2764. Origin of the planets. R. A. Lyttleton. *Observatory*, **63**, *pp.* 206–213, *Aug.*, 1940.—The author makes a comprehensive reply to Luyten's criticisms of his theory of planetary formation. [Abstract 3571 (1939).] A. Hu.

GEOPHYSICS.

GEOPHYSICS, APPLIED.

2765. The geophysical study of submarine geology. E. C. Bullard. *Roy. Inst., Proc.*, **31**, 1, *pp.* 139–147, 1940.

LAND, PHYSICS OF THE.

2766. Physical, mineralogical and durability studies on the building and monumental granites of the U.S.A. D. W. Kessler, H. Insley and W. H. Sligh. *Bureau of Standards, J. of Research*, **25**, *pp.* 161–206, *Aug.*, 1940.—Tests on 116 samples of granite (including the "black granites") from the principal producing districts of the U.S.A. gave range values for various physical properties as follows: Compressive strength, 7 700 to 53 800 lb./in.^{2}; absorption (48 hr. immersion), 0·02 to 0·58%; porosity, 0·40 to 3·84%; weights, 157 to 187 lb./ft^3. The "black granites" (gabbros and basalts) were stronger, denser and less absorptive, than the normal granites. Tests on a few selected samples gave a range of values for shearing strength of 3 900 to 4 600 lb./in^2.; modulus of rupture, 1 430 to 5 190 lb./in^2.; abrasive hardness (H_a) 37 to 88; toughness, 8 to 27. In compression granite is stronger than other types of masonry materials except for some quartzites, whereas slate and some of the serpentines are stronger than granite in flexure. The porosity of granite is of the same order as that of the marbles, slates and quartzites, but much lower than that of most other masonry materials. Although granite ranks as a heavy masonry material, the unit weight of a normal granite is somewhat less than that of marble, slate and serpentine. Inspections of granite structures have shown several cases in which the granite scaled to a depth of a few hundredths of an inch over a portion of the surface. Chemical and microscopic studies showed that $CaSO_4$ was present in the decayed granite but not in newly quarried granite. Experiments were made to determine if $CaSO_4$, leached into the granite from external sources or formed in the granite by the action of acids of sulphur on calcite ingredients would produce scaling. Leaching with a 10% solution of H_2SO_4 caused some granites to disintegrate within 30 days, but leaching with a saturated solution of $CaSO_4$ produced no decay in 3 years. It was concluded that the conversion of calcite ingredients to $CaSO_4$ by acids of sulphur is the probable cause of scaling. AUTHORS.

2767. Periodicity in terrestrial processes. J. H. F. UMBGROVE. *Am. J. Sci.*, **238,** *pp.* 573–576, *Aug.*, 1940.—This paper is a condensed synopsis of various lines of research all giving converging evidence toward the idea of periodicity in the earth. Several groups of periodic phenomena on the earth's surface, although widely differing in nature, appear to be correlated in time and point to a common, deep-rooted condition of the earth. AUTHOR.

See also Abstracts 2733, 2765, 2811.

METEOROLOGY.

2768. Distortion of stream fields by small heat sources. J. J. GEORGE. *Monthly Weather Rev.*, **68,** *pp.* 63–66, *March*, 1940.—The author considers the behaviour of air passing over a warm lake 200 miles on each side under certain assumed conditions of gradient wind velocity and lapse rate. The circulations possible on these assumptions may be modified by certain factors which are enumerated. It is difficult to test the theory by balloon observations near the Lakes, owing to the presence of cloud, etc., yet, one set, on March 7, 1939, together with observations near New Orleans, support the theory. The conclusions are: (1) an increase in surface wind velocities on the right of the lee shore of lakes; (2) an increase in velocity at the top of the convective layer to the left, and a decrease to the right, of large warm lakes; (3) these effects vary from the formation of thermal cyclones with very light winds, to a steepening of lapse rates for high winds; (4) stationary pseudo-fronts are formed under certain local conditions. A. E. M. G.

2769. Relation of weather factors to wheat yields on Levan Ridge, Utah. N. E. ZINK. *Monthly Weather Rev.*, **68,** *pp.* 66–71, *March*, 1940.—The factors likely to affect any wheat yield are indicated. To test which of these are significant in the present case 120 combinations of weather factors and crop yield for the 25 years (1908–1933) were studied. It is found that the conditions in the spring period, and particularly in the period of 2 to 3 weeks preceding heading, are very important. Highest correlations were found with evaporation, length of drought and rainfall. Very low yields appear to be due to unmeasurable causes or to a combination of causes. Correlations for plant-growth stages give somewhat higher coefficients than seasonal data afford. A series of diagrams illustrate the relations between crop yield and different weather factors, while various correlation coefficients are given in tabular form. A. E. M. G.

***2770. Improved design of cup anemometer.** P. A. SHEPPARD. *Journ. Sci. Instruments*, **17,** *pp.* 218–221, *Sept.*, 1940.—A new design of 3-cup anemometer is described possessing the following characteristics: (i) The minimum wind velocity in which the anemometer will function quite satisfactorily, about 0·2 m./sec. (40 ft./min.), is appreciably lower than usual with this type of anemometer and compares favourably with other sensitive but more troublesome types of anemometer involving moving parts. (ii) The rate of rotation of the cups is related linearly with the wind velocity and, in consequence, the indicated mean value of the velocity in a gusty wind is true, apart from the effects of inertia. (iii) The inertia of the moving parts is small so that the anemometer is very responsive to changes in wind velocity and overestimation in a gusty wind is negligibly small. (iv) The anemometer is portable and of relatively small dimensions. AUTHOR.

See also Abstract

1882B. Automatic weather station. H. Diamond and W. S. Hinman, Jr.

SEISMOLOGY.

2771. Earthquakes and structures. D. L. THORNTON. *Roy. Soc. Arts, J.*, **88,** *pp.* 800–814 ; *Disc.*, 814–815, *Aug.* 23, 1940.—After a brief account of the chief types of earthquake waves their mode of action on buildings is discussed and illustrated by seismographic curves obtained in buildings, and by the actual damage caused by a recent earthquake. The effect of the nature of the foundations, showing the increased sensitiveness to vibratory motion of waterlogged soil, is stressed, and the effect of the natural period of vibration of the building and the necessity of avoiding resonance is emphasized. General principles to be followed in structures are given, emphasizing the value of good joints, especially near walls, low pitched and light roofs, and flat arches. C. A. S.

TERRESTRIAL ELECTRICITY AND MAGNETISM.

See Abstract 2855.

RADIOACTIVITY.

2772. Artificial radioactivity of Cr. T. AMAKI, T. IIMORI AND A. SUGIMOTO. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 975, *pp.* 395–398, *June,* 1940.—Radioactive products obtained by bombarding Cr with slow neutrons, fast neutrons and deuterons, have been investigated and their decay-curves measured with a Lauritsen electroscope. Two isotopes were established: Cr^{55} (1·7 hrs.) and Cr^{51} (about 14 days). E. E. W.

2773. Use of a grid to reduce operating voltage in Geiger-Müller counters. S. A. KORFF AND W. E. RAMSEY. *Rev. Sci. Instruments,* **11,** *pp.* 267–269, *Aug.*, 1940.

***2774. Interval meter and its application to studies of Geiger counter statistics.** R. L. DRISCOLL, M. W. HODGE AND A. RUARK. *Rev. Sci. Instruments,* **11,** *pp.* 241–250, *Aug.*, 1940.—An instrument for sorting time intervals into size classes is described. It discriminates between intervals which differ in length by only a few tenths of 1%. This makes it possible to study the time distribution of the impulses in Geiger-Müller counters. Two argon counters, excited with γ-rays and operated at rates between 0·9 and 3·0 counts/sec., gave results in excellent agreement with fluctuation theory; but a hydrogen counter, operating at rates between 1·9 and 4·5 counts/sec. and excited either with γ-rays or with light, gave results so discrepant that they cannot reasonably be explained on the basis of statistical fluctuations or instrumental errors. AUTHORS.

See also Abstracts 2778, 2866.

RADIATION.

COLORIMETRY.

2775. Colour vision and chromaticity scales. W. D. WRIGHT. *Nature*, **146**, *pp*. 155–158, *Aug*. 3, 1940.—Recent progress in research on colour vision has been chiefly (*a*) in examination of the visual purple and of the impulses sent along a nerve fibre when a single receptor is stimulated by light of various wavelengths, (*b*) in studying the different types of colour defectives, the effect of varying the angle of incidence of light on the retina and the phenomena of adaptation. In colorimetry much consideration is now being given to the proposal to use a form of diagram in which a given distance always corresponds, at least approximately, to the same amount of colour difference, in whatever part of the diagram or in whatever direction the distance is measured. J. W. T. W.

2776. Colorimetric determination of iron with salicylaldoxime. D. E. HOWE WITH M. G. MELLON. *Indust. and Engin. Chem.* (*Analytical Edition*), **12**, *pp*. 448–450, *Aug*. 15, 1940.—A spectrophotometric study of the complex formed by the action of ferric iron on salicylaldoxime has indicated that this complex might be used for the colorimetric determination of ferric iron. The complex is most suitably used for this purpose in a neutral solution, *p*H being a critical factor in the determination. The range of concentrations is from 0.05 to 10 parts per million of iron, with the limits being extended each way by proper dilution or concentration. Interfering substances are easily removed, the reagent is highly specific, and no special techniques are necessary. Salicylaldoxime is recommended as a reagent for the colorimetric identification and determination of small amounts of ferric iron. AUTHORS.

2777. Colorimetric determination of copper with triethanolamine. J. H. YOE AND C. J. BARTON. *Indust. and Engin. Chem.* (*Analytical Edition*), **12**, *pp*. 456–459, *Aug*. 15, 1940.—A spectrophotometric investigation of the colorimetric determination of copper with triethanolamine included a study of the effect of concentration of the reagent, and of ammonium, sodium and potassium salts, on the transmission of copper-triethanolamine solutions; and a test of the conformity to Beer's law at several concentrations of triethanolamine. A comparative study of the ammonia method was also made. There is little difference in the sensitivities of the copper-ammonia and copper-triethanolamine methods, though the latter is slightly more sensitive at low concentrations of copper. AUTHORS.

EMISSION.

2778. Directional correlation of successive quanta. D. R. HAMILTON. *Phys. Rev.*, **58**, *pp*. 122–131, *July* 15, 1940.—A theoretical investigation shows that there should be a correlation between the directions of propagation of the quanta emitted in 2 successive transitions of a single radiating system. This correlation is described by a function $W(\theta)$ which gives the relative probability that the second quantum will be emitted at an angle θ with the first; W is determined by the angular momenta of the 3 levels involved in the 2 transitions and by the multipole order of the radiation emitted in these transitions. The explicit forms of W for all angular momenta and for dipole and quadrupole radiation are given; experimental determination of W in any given case should limit these factors to a small number of possibilities. This has particular interest as a means of investigating the nuclear energy levels involved in γ-radiation; here W should be observable by measuring the variation with θ of γ-γ coincidence counting rates. AUTHOR.

FLUORESCENCE AND PHOSPHORESCENCE. LUMINESCENCE AND AFTERGLOW.

2779. Luminescent materials. Part II. On the fluorescence spectra of ZnS.Cu crystal phosphors at 185°, 20° and 150°C. Y. UEHARA. *Chem. Soc. Japan, Bull.*, **15**, *pp.* 214–223, *June*, 1940.—[See Abstract 1534 (1940)]. The fluorescent bands were photometered visually. The distribution is continuous with marked indication in most cases of a number of overlapping single bands. The bands have been analysed into single bands by the method of Borissow [Abstract 469 (1914)] and Schellenberg [Abstract 3250 (1932)]. For pure ZnS 4 bands are thus deduced whose peaks correspond to atomic transitions in a Zn atom. In the Cu-activated 3 other bands are deduced corresponding to atomic transitions in the Cu ion. The effects of amount of activator, temperature and flux, are discussed. J. E.

2780. Triboluminescence of sugar. F. G. WICK. *J.O.S.A.*, **30**, *pp.* 302–306, *July*, 1940.—The light emitted when sugar crystals are fractured is found to be partly due to an electric discharge in the gaseous medium surrounding the crystals. The emission is increased in intensity by the addition of fluorescent oils or dyes. Similar emission is observed on subjecting crystals to sudden large charges of temperature. The experiments described suggest that the emission also resembles phosphorescence, since pre-exposure to sources of short-wave radiation increases the effect. There may also be an emission characteristic of the triboluminescent substance itself, independent of previous excitation and of the surrounding medium. Ice is found to be phosphorescent and triboluminescent at low temperatures. A. HU.

INTERFERENCE, DIFFRACTION AND SCATTERING.

• **2781. Harmonic analysis of interference fringes produced by multiple reflection.** P. M. DUFFIEUX. *Rev. d'Optique*, **18**, *pp.* 1–19, *Jan., and pp.* 201–222, *June–July*, 1939.—The intensity curve for fringes given by an infinitely narrow spectral line can be developed as a harmonic series. For a perfect optical system the amplitudes of the terms in this series are successive powers of the reflecting power; but for imperfect surfaces they need to be multiplied by factors derived from the errors of planity and parallelism, treated as curves of probability. A number of simple cases are considered, and a new intensity distribution function is calculated. By examination of effective amplitudes for various reflecting powers the range of applicability of such functions can be determined. The classical formula for a perfect system is only valid for reflecting powers less than 0·5. No general formula can be applied to very high reflecting powers. A relationship is established between the intensity curve for fringes given by a wide spectral line and the intensity distribution in the line. The cases of a simple line and of a line with satellites, with thermal broadening, are examined. In the latter, the system of equations which resolves the hyperfine structure shows that the number of resolvable components depends on the amplitude of the errors of planity. C. B. A.

***2782. Fabry-Perot interferometers in a parallel arrangement.** L. STURKEY. *J.O.S.A.*, **30,** *pp.* 351–354, *Aug.*, 1940.—The intensity equation of 2 Fabry-Perot interferometers operated in parallel is obtained and discussed. It is observed that the distribution complementary to that of a single Fabry-Perot instrument has very significant properties and may be obtained by such an arrangement. AUTHOR.

PHOTOCHEMISTRY (INCLUDING PHOTOGRAPHY).

2783. Mercury photosensitized reactions of propane. E. W. R. STEACIE AND D. J. DEWAR. *J. Chem. Phys.*, **8,** *pp.* 571–576, *Aug.*, 1940.—An investigation has been made of the mercury photosensitized reactions of propane, alone and in the presence of hydrogen at temperatures from 25 to 323°C. The products of the reaction are predominantly hydrogen, hexanes (mainly 2, 3-di-Me-butane and 2-Me-pentane), and a small amount of higher paraffins. The quantum yield of hydrogen is approximately 0·15 at 25°C. and rises somewhat with increasing temperature. AUTHORS.

2784. Photochemical reaction between nitrous oxide and hydrogen. J. W. ZABOR AND W. A. NOYES, JR. *Am. Chem. Soc., J.*, **62,** *pp.* 1975–1981, *Aug.*, 1940.—It is shown that both water and ammonia are formed when N_2O mixed with H is irradiated. The yield of NH_3 is much smaller than that of water. The quantum yield of water formation increases with the hydrogen pressure and approaches a value of unity at room temperature. When NO is added, no NH_3 is formed. With sufficient hydrogen present no NO is produced unless this substance has been added initially to the reaction mixture. The addition of NO first lowers and then increases the quantum yield of water formation. NO is effective in aiding the removal of N-atoms, perhaps by acting as an effective third body for their recombination. AUTHORS.

2785. Systematic study of the near ultra-violet photochemical decomposition of acetone. D. S. HERR AND W. A. NOYES, JR. *Am. Chem. Soc., J.*, **62,** *pp.* 2052–2059, *Aug.*, 1940.—The quantum yields of CO formation, of ethane formation and (indirectly) of acetone disappearance, have been determined for the photochemical decomposition of acetone at wavelengths 3 130 and 2 537 Å as functions of pressure, temperature and absorbed intensity. The variation of quantum yield with wavelength necessitates either the assumption that a certain fraction of the acetyl radicals decompose spontaneously as the result of energy retained at the moment of dissociation of the acetone molecule or the assumption that a certain fraction of the acetone molecules dissociate directly into 2 methyl radicals and CO. The fraction is a function of the absorbed wavelength. A mechanism is advanced to account for the facts. Biacetyl is formed largely as a result of a wall reaction, although some homogeneous reaction between acetyl radicals must occur. The best value for the energy of activation for dissociation of the acetyl radical into CO and a methyl radical is about 18 kcal. AUTHORS.

2786. Empirical relations between speed and average grain size of a precipitation series. A. P. H. TRIVELLI AND W. F. SMITH. *Kodak Research Lab., Comm. No.* 728. *Phot. J.*, **80,** *pp.* 381–385, *Sept.*, 1940.—[See Abstract 4562 (1939)]. It has been shown in 2 new precipitation series that (1) the straight-line relation between the speed and the average grain size is a special case of a more general exponential function $S = C\bar{a}^b$,

(2) the difference in curvature of these relations with different gelatins suggests tentatively that the sensitivity distribution over the same grain-size frequency range is variable. AUTHORS.

2787. Comparison of masking methods for subtractive colour processes. A. MARRIAGE. *Phot. J.*, **80,** *pp.* 364–374, *Sept.*, 1940.—[See Abstract 263 (1939)].

2788. Some masking methods of colour correction and their practical application to the Kodak wash-off relief process. R. F. W. SELMAN. *Phot. J.*, **80,** *pp.* 375–379; *Disc.*, 379–380, *Sept.*, 1940.—The practical application of 2 photographic masking methods of colour correction calculated by Marriage for use with the Kodak wash-off relief process is described and their advantages and disadvantages are discussed. AUTHOR.

2789. Theory of subtractive colour photography. Part III. Four-colour processes and the black printer. J. A. C. YULE. *Kodak Research Lab., Comm. No.* 764. *J.O.S.A.*, **30,** *pp.* 322–331, *Aug.*, 1940.—[See Abstract 265 (1939)]. Two main types of black printer are described—(*a*) those in which the black printer is only used to increase maximum density; (*b*) those in which the total grey component of the reproduction is supplied by the black. For practical purposes the black printer density should be a function of the lowest of the equivalent densities of the 3 image components when the latter are colour-corrected to give an accurate 3-colour reproduction. Several theoretically possible but somewhat complicated methods of selecting the lowest of 3 densities are described. The use of infra-red radiation, which is the only previous known method of making a good black printer, is limited in its application, since it depends on accidental or artificially introduced relationships between visual and infra-red brightness. For accurate brightness rendering the colour-corrected 3-colour separations require further correction by means of a black printer mask. AUTHOR.

***2790. Focal isolation monochromator for the Schumann region.** A. B. F. DUNCAN. *Rev. Sci. Instruments*, **11,** *pp.* 260–261, *Aug.*, 1940.—A fluorite vacuum monochromator and auxiliary apparatus for the study of photochemical reactions in the region 1 300–1 900 Å are described. Lines in the nitrogen arc spectrum were isolated in as high as 85% purity. Estimates from 3 sources give intensities of the order of 1×10^{13} quanta/sec. for the 1 742–45 Å doublet. AUTHOR.

See also Abstract 2869.

PHOTOMETRY.

***2791. Photo-electric measurement of scale marks and spectrum lines.** G. R. HARRISON AND J. P. MOLNAR. *J.O.S.A.*, **30,** *pp.* 343–347, *Aug.*, 1940.—A new type of all-electric balancing network for photometric purposes is described, with which a single photo-tube or electron multiplier can be used to locate rapidly the centre of a scale mark or spectrum line. This device is now in use on 2 automatic measuring engines and is found to give results more reproducible than those involving setting by eye. As the enlarged image of a line passes at uniform speed across a slit behind which the multiplier is placed, the variation in light intensity produces a variable output current. The resulting voltage is applied after amplification to a delay network designed to give uniform delay and attenuation to all signals of frequency between 0 and 200 c./s. Input and output of this network are combined in phase which is opposite except for the delay, so that the voltage at any instant is balanced against the voltage produced 13 msec. previously. Thus, with proper mechanical delay, densities at points on a plate separated by as little as 20 μ can be compared, and a sharp signal is obtained at a position corresponding to the passage of the peak of a line across the slit. This pulse is used to fire a stroboscopic lamp which records instantaneously the reading of a dial which measures the position of the plate. Plates are usually scanned at 4 mm./sec., and the positions of as many as 4000 lines can be recorded to within 1 μ or less in 120 sec. AUTHORS.

POLARIZATION.

2792. Effect of hyperfine structure upon the magnetic rotation of the plane of maximum polarization of resonance radiation. B. J. MILLER. *Phys. Rev.*, **58,** *pp*. 258–262, *Aug*. 1, 1940.—An equation has been developed for the polarization and the angle of maximum polarization of resonance radiation as observed along a magnetic field perpendicular to the electric vector and the direction of propagation of the incident beam. Explicit application has been made to the polarization and the angle for the line $^1S_0 - {}^1P_1$ for various values of the ratio of the hyperfine separation constant to the natural breadth of the levels for a nuclear moment of $\frac{1}{2}$. It was noted here that the form of the curves might differ widely from that to be expected from classical considerations. The polarization and the angle of maximum polarization for the sodium D lines, for several values of the same ratio, were computed and compared with experimental observations. Thus a range of possible values of A was determined, which is not in disagreement with previous figures, and a value for τ established which agrees well with that calculated from optical dispersion data. AUTHOR.

2793. Magneto-optic rotation : carbon disulphide and benzene solutions. C. E. WARING, H. HYMAN AND S. STEINGISER. *Am. Chem. Soc., J.*, **62,** *pp*. 2028–2031, *Aug*., 1940.—The Verdet constants of different solutions of carbon disulphide and benzene were determined together with the partial Verdet constants. A correlation is shown with similar data in the literature. The possibility of the determination of intermolecular structure from Verdet constants is suggested. AUTHORS.

See also Abstract 2727.

REFLECTION, REFRACTION AND DISPERSION.

2794. Aplanatic surfaces. S. MARUYAMA. *Phys. Math. Soc. Japan, Proc.*, **22,** *pp*. 320–325, *April*, 1940.—A mathematical investigation of the properties of a centred optical system. It is shown that the addition of one or several aplanatic surfaces to an aplanatic system results in an aplanatic system with a different curvature of field. By the displacement of the aplanatic surface the curvature of the field can be changed without affecting spherical aberration or coma. C. B. A.

2795. Optical dispersion and molar refraction at zero frequency for compressed nitrogen, argon and carbon dioxide, measured as functions of density. C. E. BENNETT. *Phys. Rev.*, **58,** *pp*. 263–266, *Aug*. 1, 1940.—Data obtained by displacement interferometry have been reduced to give the variation of refractive index at infinite wavelength with density for pure N up to 0·016 56 gm./cm^3. Precise data are also presented for dispersion in pure A, and the Cauchy constants under NTP conditions are evaluated as follows for this gas : $A_0 - 1 = 0{\cdot}000\,277\,1 \pm 0{\cdot}000\,000\,8$.

$B_0 = 1{\cdot}477 \times 10^{-14}$. It is also noted that the Lorentz-Lorenz function, and hence the molar refraction at zero frequency, are independent of density for these 2 gases, the density range for A extending up to 0·033 42 gm./cm³. The values of molar refraction are found to be $4{\cdot}369 \pm 0{\cdot}003$ cm³. for N and $4{\cdot}138 \pm 0{\cdot}012$ cm³. for A. Preliminary work on CO_2 indicates a slight negative deviation from linearity for $(A - 1)$ with density, and a marked negative variation of the Lorentz-Lorenz function with density. The latter means a decrease in the molar refraction at zero frequency and suggests a decrease in the molar polarization with density. This is not in accord with the findings of Keyes and Oncley who report an increase of molar polarization with density for this gas. The NTP values of the Cauchy constants for CO_2 are also evaluated as follows: $(A_0 - 1) = 0{\cdot}000\,441\,9 \pm 0{\cdot}000\,003\,6$, and $B_0 = 2{\cdot}791 \times 10^{-14}$. The extrapolated value of the molar refraction at zero frequency is found to be approximately 6·65 cm³. AUTHOR.

***2796. Method for the measurement of flatness of polished surfaces.** C. TUTTLE AND R. CARTWRIGHT. *Kodak Research Lab., Comm. No.* 768, *J.O.S.A.*, **30,** *pp.* 348–350, *Aug.*, 1940.—An optical method providing for the rapid inspection of extended surfaces is described. Two beams of parallel light are reflected by the sample through a cylindrical lens to form an astigmatic image of the source. If this image is a single line the surface is flat within the accuracy of the instrument. Radii of curvature in tested samples of the order of 40 ft. can be readily detected. An inspection device for testing glass to be used for photographic purposes is now in service. AUTHORS.

See also Abstracts 2727, 2781, 2790, 2814.

SPECTROSCOPY.

2797. Spectrochemical analysis of sheet steel at the Great Lakes Steel Company. R. A. SAWYER AND H. B. VINCENT. *J. of Applied Physics*, **11,** *pp.* 452–458, *July*, 1940.—The installation used for the rapid and accurate analysis of sheet steel is described in detail. One interesting feature of the outfit is the use of a h.v. a.c. arc as light source. The secondary of a h.v. transformer is connected to the arc through a large ballast resistance which controls the current, this being generally 1 to 3 A. A potential varying from 1 100 to 4 500 V is used and the gap is made sufficiently short for the arc to re-ignite at each half-cycle. A. H.

2798. Correlation method for the elimination of errors due to unstable excitation conditions in quantitative spectrum analysis. S. LEVY. *J. of Applied Physics*, **11,** *pp.* 480–487, *July*, 1940.—It is shown that some difficulties associated with quantitative spectrum analysis cannot be removed through instrumental improvements. A survey of the most important light sources shows that the radiation of all of them is determined by only one quantity which is either the gas temperature or the electron temperature, the latter being in some cases higher than, in others equal to, the gas temperature of the discharge. The excitation energy is therefore distributed among the excited states of the atoms statistically, and the number of atoms in the various energy levels is determined uniquely by the electron or gas temperature. Consequently, the intensity ratio of 2 lines is related to the intensity ratio of 2 others. A correlation method is described which permits work under non-standardized conditions (variation of the shape of the electrodes, influence of extraneous elements, etc.) while reducing the measurements to "normal" (standard) conditions. The method can also be used under standard conditions to improve the accuracy of an analysis while eliminating errors due to accidental fluctuations in the light source. A. H.

2799. Partially inverted multiplets in MgI. L. Pincherle. *Phys. Rev.*, **58,** *pp.* 251–254, *Aug.* 1, 1940.—With the use of Fermi-Thomas statistical eigen-functions the separations of the $3s3d\,^3D$ term of MgI are evaluated, taking into account all the magnetic interactions in the atom and the electrostatic interactions with other configurations. The smallness of the observed separations is found to be due to the large value of the exchange integrals of the magnetic actions. Author.

2800. The infra-red absorptions of organic hydroxyl compounds in the solid state in the 3μ region. M. M. Davies. *J. Chem. Phys.*, **8,** *pp.* 577–587, *Aug.*, 1940.—The absorptions in the range $2{\cdot}6\,\mu$ to $3{\cdot}5\,\mu$ covering the OH and CH fundamentals, have been measured for a variety of solid organic hydroxyl compounds in the form of thin films. For simple alcoholic and carboxylic structures the results, as expected, show complete association in the condensed state. In a number of other cases a sharp band with a narrow doublet structure ($\Delta\nu \sim 40$ cm^{-1}.) is found near $2{\cdot}9\,\mu$, and this is ascribed to relatively "free" OH groups in the solid resulting either from steric protection, as in triphenylmethyl carbinol, or weak intramolecular binding as in ethyl mandelate. Two very general features are the shift of the absorptions to longer wavelengths in the condensed phases, and the doublet nature of the absorption of the "free" hydroxyl groups in the solid as well as in other phases. Both these factors are discussed in the light of the new and previous data. Author.

2801. Infra-red absorption studies of some hydrocarbons. F. T. Wall and G. W. McMillan. *Am. Chem. Soc., J.*, **62,** *pp.* 2225–2227, *Aug.*, 1940.—The infra-red absorption spectra of a number of hydrocarbons in carbon tetrachloride solution were studied in the $3{\cdot}35\,\mu$ region. The positions of the absorption maxima were correlated with the aromatic and aliphatic properties of the molecules. Authors.

2802. Infra-red absorption of the hydroxyl group in relation to inter- and intra-molecular hydrogen bonds. J. J. Fox and A. E. Martin. *Faraday Soc., Trans.*, **36,** *pp.* 897–911; *Disc.*, 911–913, *Sept.*, 1940.

2803. The spectra and molecular vibrations of glyoxal. H. W. Thompson. *Faraday Soc., Trans.*, **36,** *pp.* 988–999, *Sept.*, 1940.—The ultra-violet absorption spectrum of glyoxal vapour has been measured. There are 2 band systems: between 3 200–2 300 Å is a system of diffuse predissociated bands; irradiation of the molecule with frequencies in this region does not lead to fluorescence. From 4 780–3 400 Å is a system of fine structured bands for which a partial vibrational analysis has been made; this suggests frequencies in the ground state of 135, 550 and 1 050 cm^{-1}. Some features of the rotational structure of certain of the bands have been indicated. The infra-red absorption spectrum has been measured between 1–15 μ. The bands observed are discussed in relation to selection rules for different possible types of molecular symmetry, and a plausible assignment of the magnitudes to fundamental vibrations of the several geometric forms is made. Possible fundamentals are 135, 550, 800, 985, 1 050, 1 098, 1 150, 1 315, 1 730, 2 700 and 2 833. Although the data do not lead to an unambiguous decision between the several possible molecular structures, the planar "trans" form is not excluded. The possibility of a change in molecular symmetry on electronic excitation is considered. The fluorescence spectrum emitted in the blue and green when glyoxal vapour is irradiated with wavelengths 4 047 Å and 4 358 Å has been measured and correlated with the absorption spectrum. AUTHOR.

2804. Vibrational structure of the band spectrum of $HgCl_2$. M. WEHRLI. *Helv. Phys. Acta*, **13**, 3, *pp*. 153–159, 1940. *In German.*—The absorption spectrum of $HgCl_2$ in the range 1 650–1 750 Å has been investigated more accurately than hitherto. The selection rule that the quantum numbers of vibrations not totally symmetrical can only change by even numbers is verified. The frequencies of the 3 normal vibrations in the ground state and in the excited state of the molecule, and the electron term difference, are calculated. A. J. M.

2805. Absorption of praseodymium ion in solutions and in the solid state. F. H. SPEDDING. *Phys. Rev.*, **58**, *pp*. 255–257, *Aug*. 1, 1940.—The energy states of praseodymium IV are calculated. It is assumed in the solid and liquid phases that the sharp absorption spectrum would arise from transitions within the incomplete 4*f* shell, in other words from states arising from the f^2 configuration. Excellent agreement was found with the experimentally observed values of Pr IV. AUTHOR.

2806. Absorption spectra of metal complexes of 2, 2′-dipyridyl. Part III. K. YAMASAKI. *Chem. Soc. Japan, Bull.*, **15**, *pp*. 130–137, *April*, 1940. *In German.*—The following complexes of Co chloride with 2, 2^1-dipyridyl have been prepared and their absorption spectra recorded for both solid and dissolved states: $[Co\,Cl_4]\,(H_2\,\mathit{Dip})$, Co *Dip* $Cl_2 \cdot H_2O$, Co *Dip* $Cl_2 \cdot 4H_2O$, Co *Dip* Cl_2 (green and blue forms). [See Abstract 4534 (1938).] C. B. A.

2807. Absorption and fluorescence spectra of certain dihydroisobenzofurans and isobenzofurans. R. ADAMS AND M. H. GOLD. *Am. Chem. Soc., J.*, **62**, *pp*. 2038–2042, *Aug*., 1940.—The preparation of certain dixenyldihydroisobenzofurans and isobenzofurans is described. The absorption spectra and fluorescence spectra of various diphenyl and dixenyldihydroisobenzofurans and isobenzofurans were compared. The substitution of xenyl for phenyl groups in absorption spectra shifts the band maxima toward the visible by about 200–300 Å, and in fluorescence spectra shifts the wavelength at which emission begins about 375 Å toward the red. A discussion of fluorescence change in relation to the tendency of the molecules to give free radicals is given. AUTHORS.

See also Abstracts 2779, 2792.

VISION.

See Abstract 2775 and
1860B. Physical realization of the eye. G. T. Winch and C. F. Machin.

X-RAYS.

2808. Nomogram for the determination of lead protection against h.v. X-rays. W. BINKS. *Brit. J. of Radiology*, **13**, *pp*. 322–323, *Sept.*, 1940.—A nomogram is given which, from a knowledge of the tube voltage, tube current and distance, enables the amount of lead to be found which is necessary to give adequate protection against h.v. X-radiation. AUTHOR.

2809. X-ray emission spectra and electronic energy bands of compounds. J. Valasek. *Phys. Rev.*, **58**, *pp.* 213–218, *Aug.* 1, 1940.—Measurements of emission wavelengths in the $K\beta$ group of Ca and S in CaS and $CaSO_4$, of Mg and S in MgS, of S in SrS and BaS, of Ca and Cl in $CaCl_2$, have been made from the secondary radiation from pressed blocks of the salts. An attempt is made to determine the origin of as many X-ray lines as possible by means of electronic energy band systems in the cases of CaS, MgS, and ZnS. The $K\beta_5$ line of Zn and ZnS and the $K\beta_1$ line of Mg in MgS are found to be due to cross transitions from the outermost filled band of the negative ion. Author.

See also Abstracts 2862, 2869.

HEAT.

CALORIMETRY.

2810. Gaseous heat capacities. Parts II and III. G. B. Kistiakowsky and W. W. Rice. *J. Chem. Phys.*, **8**, *pp.* 610–622, *Aug.*, 1940.—The present papers describe a continuation of work [see Abstract 2564 (1939)] on the heat capacities of lower hydrocarbons by the Lummer-Pringsheim adiabatic expansion method. Authors.

See also Abstracts 2754, 2823.

CONDUCTION.

***2811. The thermal conductivity of rocks and its dependence upon temperature and composition.** F. Birch and H. Clark. *Am. J. Sci.*, **238**, *pp.* 529–558, *Aug., and pp.* 613–635, *Sept.*, 1940.—An apparatus for the measurement of absolute thermal conductivity between 0 and 500°C. is described. Results are given for 18 igneous rocks, 7 sedimentary and metamorphic rocks, 3 single crystals and 4 glasses. The conductivities of the poorest conductors, glasses and feldspar aggregates, increase with the temperature ; the conductivities of all of the other materials decrease as the temperature increases. The aggregates having the highest conductivities are the ultrabasic rocks. The results are discussed in the light of theories of heat conduction in crystals. A simple method of computation is shown to account for the conductivities of fresh igneous rocks in terms of their mineral compositions and the measured conductivities of approximately monomineral aggregates. Authors.

2812. Orientation of liquid crystals by heat conduction. G. W. Stewart, D. O. Holland and L. M. Reynolds. *Phys. Rev.*, **58**, *pp.* 174–176, *July* 15, 1940.—This is a new phenomenon in heat conduction in which the "liquid crystals" of para-azoxyanisol acquire a preferred orientation under the action of heat conduction in the liquid. A temperature gradient of but 1 or 2 deg./cm. at a temperature of approximately 125°C. is sufficient to give a marked effect. The orientation is indicated by the variation in intensity in the X-ray diffraction halo. Both the effect and its magnitude are rather surprising, and it is anticipated that the explanation may rest in the dominance of acoustic waves of inertia and viscosity in heat conduction in liquids, as described by Lucas. Authors.

DILATATION.

2813. Thermal coefficient of expansion of Portland cement. S. L. Meyers. *Indust. and Engin. Chem.*, **32,** *pp.* 1107–1112, *Aug.*, 1940.—The thermal coefficient of expansion appears to increase with the theoretical quantity of cement gel present if the cement gel is neither desiccated nor saturated with water. The coefficient decreases after long periods of time as the cement gel becomes a metacolloid; any condition which accelerates this process decreases the coefficient. Neat Portland cement and concrete have lower coefficients under the conditions of water storage, steam treatment and very dry storage, than under conditions of storage, without gain or loss of water. The thermal coefficients of the 4 cement compounds are affected by storage conditions involving changes in humidity in the following order: tricalcium silicate, tetracalcium aluminoferrite, dicalcium silicate, tricalcium aluminate. The latter is affected very little or not at all. Since the thermal coefficients of different concretes vary over a wide range under different storage conditions as well as with the kind of concrete made, this variation should receive some consideration in the design of concrete structures. Author.

FUSION AND SOLIDIFICATION.

2814. Some properties of monoethanolamine and its aqueous solutions. R. E. Reitmeier, V. Sivertz and H. V. Tartar. *Am. Chem., Soc. J.*, **62,** *pp.* 1943–1944, *Aug.*, 1940.—The following properties of monoethanolamine are presented: melting point, boiling point, refractive index, surface tension and parachor; also the surface tension of aqueous solutions at concentrations 0·1 *M* and below. Authors.

2815. Fundamental studies of the glass melting process. The effect of particle size and temperature on the rate of glass formation of a pure soda-lime-silica glass. E. Preston and W. E. S. Turner. *Soc. Glass Technol., J.*, **24,** *pp.* 124–138, *June*, 1940.—A study has been made of the rate of melting in small Pt elliptical capsules heated in an electric furnace of a batch mixture, of approximately 2·5 gm. in amount, yielding a glass of percentage composition 73·5 SiO_2, 10 CaO, 16·5 Na_2O. Pure soda-ash and calcium carbonate, both of controlled constant particle size, were employed together with silica grains in 1 of 2 forms, the first derived from pure Brazilian quartz, the second from a sieved Dutch sand. Quenched Brazilian quartz was found to break down with peculiar characteristics leading to grains mainly of columnar or needle shape. As the result of a series of experiments at temperatures ranging from 1 100° to 1 450° it was shown that the rate of glass melting was approximately doubled for each 50 deg. rise in temperature. The rate at any one temperature was found to be proportional to the area of the grains of silica. The violent chemical reactions were found to occupy 10% of the total time of glass melting, and the solution of the residual silica 90%. Under the conditions of experiment the solution of the residual silica was at the rate of 0·003 mm./min. of the grain diameter. Authors.

See also Abstracts 2732, 2824.

THERMOCHEMISTRY.

2816. Conductance, dissociation constant and heat of dissociation of triethylamine in water. J. E. Ablard, D. S. McKinney and J. C. Warner. *Am. Chem. Soc., J.*, **62,** *pp.* 2181–2183, *Aug.*, 1940.

2817. Phenomena in the ignition of fire-damp by explosives. Part I. Particles from the detonation. S. L. Gerhard and W. J. Huff. *Bureau of Mines, Techn. Paper, No.* 603, [17 *pp.*], 1940.—The work described in this paper deals with the initial results of a research conducted by the Explosives Division of the Bureau of Mines for the examination of the phenomena which occur when an explosive is fired into gas-air mixtures. The study is closely related to the conditions that accompany the use of explosives in mines and to the performance tests established by the Bureau of Mines in the control of permissible explosives. The work shows that particles are ejected when an explosive is detonated. Some of these from American explosives appear to be inert and others may be actively decomposing. Balloons filled with explosive gas-oxygen mixtures have been ignited even when no sparks were visible. The results indicate that the particles alone may have been responsible for the ignition of the balloons, but the proof that incendive particles can ignite firedamp under mining conditions is not yet complete. R. W. P.

2818. Effect of surface on cool flames in the oxidation of propane. R. A. Day, Jr., and R. N. Pease. *Am. Chem. Soc., J.*, **62,** *pp.* 2234–2237, *Aug.*, 1940.—The cool flame region in 1 : 1 propane-oxygen mixtures is not materially affected by etching the reaction tube or coating it with potassium chloride. It is thus determined by conditions in the gas phase. Attention is drawn to the region of negative temperature coefficient of the rate as an effective control, leading to successive flames and preventing ignition. Authors.

See also Abstract 2822.

THERMODYNAMICS.

2819. Thermodynamics of irreversible processes. Parts I and II. C. Eckart. *Phys. Rev.*, **58,** *pp.* 267–275, *Aug.* 1, 1940.—The rate of increase of the entropy of a simple viscous fluid capable of conducting heat is investigated in great detail. It is shown that, if Kelvin's hypothesis concerning the absolute temperature be adopted and the usual law of viscosity be assumed, the requirements of the second law are satisfied. The possibility of constructing a systematic theory of irreversible processes is surveyed in general terms by utilizing some of the results established in later parts of the paper. Three assumptions underlying Gibbs' application of the second law to equilibrium problems are formulated in explicit but general mathematical form. It is shown that they restrict the equations governing irreversible changes. The theory of a general fluid mixture is developed in some detail and is then applied to mixtures of ideal gases. It is shown that the usual equations of the velocity of chemical reactions are consistent with the second law provided that the departure from equilibrium is not too great. Mathematical complexities make it difficult to decide whether this is the case for larger deviations also. A somewhat general theory of diffusion and heat flow is considered and the requirements of the second law are formulated as the positive definiteness of a certain matrix whose elements depend on the diffusion coefficients, thermal conductivity, etc. Author.

2820. Two-phase equilibrium in binary and ternary systems. Part II. The system methane-ethylene. Part III. The system methane-ethane-ethylene. M. Guter, D. M. Newitt and M. Ruhemann. *Roy. Soc., Proc. A*, **176,** *pp.* 140–152, *Aug.* 28, 1940.—[See Abstract 2154 (1939)]. The liquid-vapour equilibrium of the system methane-ethylene has been determined at 0, − 42, − 78, − 88 and − 104°C. over a wide range of pressures and the results are shown on a pressure-composition-temperature diagram and by a series of pressure-composition curves. The liquid-vapour equilibrium of the ternary system methane-ethane-ethylene has been determined at − 104, − 78 and 0°C. Values for the two binary systems methane-ethane and methane-ethylene and for the ternary system methane-ethane-ethylene are shown on a composite pressure-composition diagram. AUTHORS.

2821. Thermodynamic properties of methyl cyanide and methyl isocyanide. R. H. EWELL AND J. F. BOURLAND. *J. Chem. Phys.*, **8**, *pp.* 635–636, *Aug.*, 1940.

2822. Ionic entropies and free energies and entropies of solvation in water-methanol solutions. W. M. LATIMER AND C. M. SLANSKY. *Am. Chem. Soc., J.*, **62**, *pp.* 2019–2023, *Aug.*, 1940.—Ionic entropies, free energies and entropies of solvation, for the pairs of ions: $H^+ + Cl^-$, $K^+ + Cl^-$, and $K^+ + Br^-$ have been calculated for water-methanol mixtures whose compositions range from pure water to pure methanol. These values are discussed with reference to the nature of the solvation process. AUTHORS.

2823. Heat capacity and entropy, heats of fusion and vaporization and the vapour pressure, of isobutane. J. G. ASTON, R. M. KENNEDY AND S. C. SCHUMANN. *Am. Chem. Soc., J.*, **62**, *pp.* 2059–2063, *Aug.*, 1940.

2824. The heat capacity and entropy, heats of fusion and vaporization and the vapour pressure, of *n*-butane. J. G. ASTON AND G. H. MESSERLY. *Am. Chem. Soc., J.*, **62**, *pp.* 1917–1923, *Aug.*, 1940.—The heat capacity of *n*-butane is measured from 12°K. to the boiling point. The transition point, melting point and boiling point are determined. The heats of transition, fusion and vaporization, at the boiling point are given. It is shown that reliable thermodynamic functions for *n*-butane at high temperatures may be obtained despite uncertainty in the vibrational frequency assignment.

2825. Joule-Thomson effect in mixtures of He and A. J. R. ROEBUCK AND H. OSTERBERG. *J. Chem. Phys.*, **8**, *pp.* 627–635, *Aug.*, 1940.—The Joule-Thomson effect has been measured in 4 mixtures of He and A. The apparatus and methods are those used repeatedly in previous work. The measurements of the isenthalpic curves cover the range − 100° to 250°C. and up to 200 atm. From these measurements μ has been computed and plotted, and the trends with temperature, pressure and composition, are shown; μ is read from these curves and tabulated. In part of the region $\mu = 0$, and these inversion curves are plotted as functions of pressure, temperature and composition. Mixtures of He and N have been similarly measured. AUTHORS.

***2826. Hydraulic demonstration apparatus for the determination of the mechanical equivalent of heat.** H. GREINACHER. *Helv. Phys. Acta*, **13**, 3, *pp.* 160–166, 1940. *In German.*—A method of determining the mechanical equivalent of heat depending on the heat absorbed when a liquid expands from a pressure p_2 to another p_1 is developed, and the apparatus is described. If the temperature difference is Δt, and pressure difference is Δp, $J = \Delta p / \Delta t$, if the liquid used is H_2O. The method has the advantage that no calorimeter is required, and that a steady temperature difference has to be measured, so that heat loss is not of great importance. The temperature difference is measured with thermo-couples. A. J. M.

VAPORIZATION AND CONDENSATION.

2827. The Duhem-Margules equation and Raoult's law. C. R. BURY. *Faraday Soc., Trans.*, **36**, *pp.* 795–797, *Aug.*, 1940.—It is pointed out that the thermodynamical treatment of the Duhem-Margules equation, and of Raoult's law of partial vapour pressures, given in most text books is misleading or inaccurate. An equation of more general validity is derived which includes the Duhem-Margules equation as a special case. This modification introduces an additional term into the derived expression which forms the basis of Raoult's law, but, as the term is small, partial pressures derived from the new equation will in general be indistinguishable from those calculated by means of Raoult's law. R. W. P.

2828. Partial pressure of hydrogen chloride from its solutions in the mono-halobenzenes at 25°. S. J. O'BRIEN AND J. B. BYRNE. *Am. Chem. Soc., J.*, **62**, *pp.* 2063–2065, *Aug.*, 1940.

See also Abstracts 2814, 2823, 2824.

ACOUSTICS.

2829. Sound pressure on spheres. F. E. FOX. *Acoustical Soc. of America, J.*, **12**, *pp.* 147–149, *July*, 1940.—The theory of King for the radiation pressure exerted by plane progressive waves on spheres has been used to compute the constants for spheres of radii (r) of the order of a wavelength (λ) of the sound in the medium. These are given for integer values of $\alpha = 2\pi r/\lambda$ from 1 to 11, and for $\alpha = 15$ and 20. For larger α the constants approach a limiting value so that one may use a simple approximation to obtain the constants for such spheres. AUTHOR.

2830. Some acoustical source-observer problems. S. W. REDFEARN. *Phil. Mag.*, **30**, *pp.* 223–236, *Sept.*, 1940.—In view of the practical importance of the problem of the reduction of noise at a point due to an unavoidable source of sound situated at a second point, certain aspects forming a logical sequence have been selected for a theoretical treatment from as general a point of view as possible. The first relates to barriers, the second to the enclosure of the source, and the third to the enclosure of the point of observation. In all cases connected with a simple source of sound and a point of observation the Helmholtz reciprocal principle holds, and two applications of this are given, in connection with the sound transmitted round a barrier, and in connection with the problem of an enclosed source. AUTHOR.

2831. Some notes on end-corrections. L. C. TYTE. *Phil. Mag.*, **30**, *pp.* 173–184, *Sept.*, 1940.—It is shown that the experimental results of Bate and Wilson on the end-corrections of cylindrical pipes surmounted by conical flanges are in agreement with the values calculated from an expression derived earlier by the writer for a pipe with an infinite conical flange. The effect of plane flanges placed against one or two sides of a square organ-pipe is then discussed from considerations of electrical conductance, and the ratio of the calculated corrections is in agreement with experimental values previously obtained. Finally, for the end-correction due to an orifice in a diaphragm an empirical expression has been derived relating the reciprocal of the end-correction to the area of the orifice. AUTHOR.

2832. Ultrasonics and elasticity. H. F. LUDLOFF. *Acoustical Soc. of America, J.*, **12**, *pp.* 193–197, *July*, 1940.—Ultrasonic vibrations are induced in small pieces of glass, metal or crystals, by means of piezo-quartz plates cemented to their sides. In this way spatial gratings are formed in the solid by standing waves and, if light from a small slit is projected on to the solid, interference patterns will be obtained, in the transmitted light for transparent solids and in the light reflected from the vibrating surface of an opaque solid. The form of the interference figures depends only on the elastic properties of the vibrating solid and is quite independent of its shape. If the elastic constants are known the interference patterns can be calculated and, conversely, the constants can be determined with considerable accuracy from comparison of experimental and theoretical interference patterns. For application to the study of elastic moduli over wide ranges of temperature, possibly up to the melting point, the general temperature law for the elastic parameters of solids has been derived; this can be verified by the results of Quimby and his collaborators. For the bulk modulus B it is here shown that at low temperatures B decreases in proportion to the 4th power of the absolute temperature, but at high temperatures B depends almost linearly on the temperature. Durand's measurements on MgO are in good agreement with this. Smooth temperature curves of the elastic parameters are, however, seldom realized. Most materials have several phase transition points at which the atoms of the lattice change suddenly from one configuration to another. At such points the temperature curves are interrupted by discontinuities or kinks, as shown in Lawson's results for NH_4Cl. A. W.

2833. Non-uniform acoustical boundaries in rectangular rooms. DAH-YOU MAA. *Acoustical Soc. of America, J.*, **12**, *pp.* 39–52, *July*, 1940.—An exact solution is presented for the behaviour of sound in a rectangular room whose walls are covered non-uniformly with acoustical materials. The sound field in the room is first decomposed into normal modes of vibration. By assuming the characteristics of an acoustical material to be representable by its specific acoustic admittance, the normal frequency, decay constant and pressure configuration, of each normal mode of vibration are determined as functions of the room dimensions and the distribution of acoustical materials in the room. An approximate theory is also presented, applicable to cases in which the diffracted reflections from the walls can be neglected. It is shown that the effect due to diffraction can be superposed on the result from the approximate theory. Experiments were performed in confirmation of the theoretical results. Applications of the theory to practical problems, such as measurements on acoustical materials, acoustical design of rectangular rooms, etc., are discussed. The possible extension of the present theory to the case of non-rectangular rooms is discussed. AUTHOR.

2834. Starting characteristics of speech sounds. R. O. DREW AND E. W. KELLOGG. *Acoustical Soc. of America, J.*, **12**, *pp.* 95–103, *July*, 1940.—In view of its bearing on the design of ground noise reduction systems a study was undertaken to determine how sudden or rapid are the increases in amplitude of the speech sounds that must be recorded in dialogue. A large number of oscillograms were taken. The most important observation is that the human voice can start several of the vowel sounds in such a way that the first wave is from 40 to 80% of the final amplitude or, in other words, with a suddenness comparable to that of keying an oscillator. Progressive build-up at rates which would carry the modulation from zero to 100% in 0·05 sec. are frequent, while the great majority of syllables start more gradually than this. AUTHORS.

***2835. Attenuation of sound in tubes.** R. D. FAY. *Acoustical Soc. of America, J.*, **12**, *pp.* 62–67, *July*, 1940.—Refinements in method and apparatus have made possible the precise measurement of attenuation of sound in tubes. Preliminary results check the tube wall effect predicted by Kirchhoff very closely. An unexpectedly large effect depending on the first power of the frequency is also found. Further measurements are required to find whether this loss exists in free air or is due in part to the tube walls. AUTHOR.

2836. Variable boundary impedance for room acoustics investigations. R. H. BOLT AND R. L. BROWN. *Acoustical Soc. of America, J.*, **12**, *pp.* 31–38, *July*, 1940.—A method has been developed for obtaining a wide range of impedance values, both as to magnitude and phase angle. In one form a variable impedance unit consists of (1) a steel face with perforations of variable area (obtained by overlapping identically drilled plates), (2) a " resistance " element—a layer of porous absorbing material with appropriate flow resistance, (3) a " mass " element—a solid board through which small channels are drilled at uniform spacing over the whole surface, and (4) a " stiffness " element—a cavity of variable depth backed by a rigid steel plate. The behaviour can be predicted approximately by analysis of an equivalent electrical circuit. A unit with face 8 × 8 in. has been built, and calibrated at several frequencies, using a straight acoustic impedance line of the same sectional area. The useful range appears to include phase angles from $-60°$ to $+45°$ and magnitudes of $z/\rho c$ from 0·4 to 10, for frequencies between 250 and 800 c./s. Normal incidence "absorption coefficients" of 99% have been obtained. In using this type of impedance structure with non-normally incident sound it is found necessary to break up the backing cavity into cells of small transverse section compared with a wavelength. This modification minimizes tangential components of particle velocity and renders the specific acoustic impedance at the face essentially independent of angle of incidence and of the area of the surface and yields a marked increase in " average absorption coefficient." AUTHORS.

2837. Absorption of sound by small areas of absorbing material. J. R. PELLAM AND R. H. BOLT. *Acoustical Soc. of America, J.*, **12**, *pp.* 24–30, *July*, 1940.—An indirect experimental check is now obtained for the calculated " shape factor " for an absorbing strip of material in a reflecting wall, reported previously [Abstract 1898 (1940)]. The effect of the strip on each of the component " partial waves " in the incident plane wave is studied by placing the strip in a special enclosure, the shape of which allows the partial waves to be studied individually as isolated normal modes of vibration. A semicylindrical room is employed; its concave wall tends to " focus " sound upon the centre of the opposite flat wall on which the absorbing panel is centred. If the wave equation is set up in elliptic cylinder co-ordinates with the edges of the panel as foci, the boundary conditions are readily satisfied. The theory is strictly applicable to a semi-elliptical room only but holds well in the semicircular for strip widths up to $\frac{1}{3}$ the diameter. The experimental enclosure has a 14 in. radius, a " thickness " of 4 in. between the parallel walls, and is constructed with highly reflective metal surfaces. The selective damping of various normal modes is investigated for strip widths from about 1 to 10 in. for several values of normal acoustic impedance. The results substantiate the calculated values of " shape factor " which were given in the previous paper. AUTHORS.

2838. Shock waves in air and characteristics of instruments for their measurement. L. THOMPSON. *Acoustical Soc. of America, J.*, **12**, *pp.* 198–204, *July*, 1940.—Discussion of the properties of shock waves is followed by a short account of Hugoniot's method of treatment which offers certain advantages over the classical theory. Using the Hugoniot velocity for the shock wave in combination with the dynamic equation of condition the equations for pressure and density are stated in terms of wave velocity. A table is given containing numerical estimates of certain characteristics of shock waves at various distances from sources of great intensity, ranging from the firing of a rifle to the explosion of 1 000 lb. of TNT. With simultaneous measurements of both amplitudes it is believed possible to deduce not only the ratio of specific heats for these cycles but also that equation for pressure-density relation which describes the conditions existing in these transient states. Various possible methods of measuring (*a*) condensation and (*b*) compression are discussed. Apparatus is illustrated and described for obtaining a dynamic calibration of piezo-electric pressure gauges. A. W.

2839. Sound measurement objectives and sound level meter performance. J. M. BARSTOW. *Acoustical Soc. of America, J.*, **12**, *pp.* 150–166, *July*, 1940.—Standardization of sound level meters, based on tests carried out during recent years, has led to improved conditions in the field of sound measurement, although several characteristics considered desirable in visually indicating sound measuring devices are not fully realized in present instruments. Much experimental work is described and curves are given relating sound, loudness, frequency, etc. Present indications are that it will be difficult to remove sound level meter limitations with regard to the approximation of average loudness levels and, at the same time, retain reasonable simplicity of apparatus.

E. H. W. B.

***2840. Sound level meters from the user's viewpoint.** P. HUBER AND J. M. WHITMORE. *Acoustical Soc. of America, J.*, **12**, *pp.* 167–172, *July*, 1940.—Commercial sound level meters are analysed and characteristics are given. Such instruments comprise a microphone, amplifier and output meter. Amplifier troubles are rare, and the only serious trouble is change of amplification with change of voltage, but this is overcome if negative feed-back is employed. Microphones are either of the moving-coil (dynamic) or the crystal type, and the characteristics of each are discussed. Curves are given for representative commercial instruments. The output meter is considered to be the most serious source of error. It is of the rectifier type and in some cases has led to errors of 5 db. The A.S.A. tentative standard, Z. 24·3—1936, gives a tolerance of 5 db, but it is now considered that this can be improved upon, although generally manufacturers will give no guarantee. E. H. W. B.

ELECTRICITY AND MAGNETISM.

CONDUCTION IN SOLIDS AND LIQUIDS.

2841. Conductance of ethylene dichloride solutions of some quaternary ammonium salts having large negative ions. D. L. Fowler and C. A. Kraus. *Am. Chem. Soc., J.*, **62,** *pp.* 2237–2240, *Aug.*, 1940.—The conductance of the following salts has been measured in ethylene dichloride solution at 25·00°: $(n\text{-}C_4H_9)_4NOH\cdot B(C_6H_5)_3$, $(n\text{-}C_4H_9)_4NF\cdot B(C_6H_5)_3$, $(CH_3)_4NOH\cdot B(C_6H_5)_3\cdot C_2H_5OH$, $(CH_3)_4NOH\cdot B(C_6H_5)_3\cdot H_2O$ and $(CH_3)_4NF\cdot B(C_6H_5)_3$. The Λ_0 values for the two tetrabutylammonium salts were found to be practically identical—52·3 and 52·4. Assuming the tetrabutylammonium ion and the triphenylborofluoride ion (or the corresponding hydroxy ion) to have the same mobility, the conductance of each of the two ions is 26·2. The complex fluoride was found to be more stable than the corresponding hydroxide. Dissociation constants of the ion-ion pair equilibrium have been computed. Salts with larger ions have larger dissociation constants. Authors.

See also Abstract

1808B. Comparison of standard resistors. F. Wenner.

DIELECTRICS AND CAPACITANCE.

2842. Dipole moments of amine oxides. E. P. Linton. *Am. Chem. Soc., J.*, **62,** *pp.* 1945–1949, *Aug.*, 1940.—A heterodyne beat apparatus has been employed to measure the dipole moments of trimethylamine oxide, dimethylaniline oxide and pyridine oxide in benzene and in dioxane. The results support the electronic structures assigned to trimethylamine oxide and dimethylaniline oxide but it is concluded that pyridine oxide resonates among several structures. The relation of the dipole moments of the amine oxides to other physical properties is discussed. The value 4·38 calculated for the dipole moment of the $^{+}N\text{–}O^{-}$ link is larger than the moments of other semipolar bonds and an explanation of this difference is given. Author.

ELECTROCHEMISTRY.

2843. Temperature variation of the ionization constants of weak electrolytes. H. S. Harned and R. A. Robinson. *Faraday Soc., Trans.*, **36,** *pp.* 973–978, *Sept.*, 1940.—Five equations representing the temperature variation of the ionization constants of weak electrolytes have been compared with the experimental data. Three of these have been shown to be capable of representing the observed data within the limits of experimental error. From these 3 one has been selected as giving as good a representation of the data as the other 2 and, moreover, lending itself to least squaring with ease and rapidity and without recourse to graphical methods. The result of a critical survey of the best data on the ionization constant of water is presented. Authors.

2844. Mixed potentials at the dropping mercury electrode. I. M. Kolthoff and C. S. Miller. *Am. Chem. Soc., J.*, **62,** *pp.* 2171–2174, *Aug.*, 1940.—The significance of " mixed potentials " at the dropping mercury electrode is explained. Various examples of current/voltage curves in mixtures which yield mixed potentials have been given. Although thallous thallium does not react chemically with cyanide its " apparent " reduction wave is shifted to more negative potentials in the presence of cyanide. The principle of a new type of amperometric titration, in which the substance titrated and the titrating agent do not react chemically, is described. AUTHORS

***2845. Universal *p*H meter and simplified vacuum tube electrometer.** F. M. GOYAN, C. L. BARNES AND H. W. HIND. *Indust. and Engin. Chem.* (*Analytical Edition*), **12,** *pp.* 485–488, *Aug.* 15, 1940.—A circuit capable of transforming a potentiometer and standard cell into a direct-reading *p*H meter is described. This circuit is self-calibrating and may be used with the glass, hydrogen, quinhydrone, or other electrode systems in connection with a suitable electrometer. The design of a simplified vacuum tube electrometer is also given and some typical results with various electrodes are recorded. AUTHORS.

ELECTRONS, NEUTRONS, POSITRONS AND PROTONS.

2846. Theoretical constitution of metallic Be. C. HERRING AND A. G. HILL. *Phys. Rev.*, **58,** *pp.* 132–162, *July* 15, 1940.—Calculations of total energy as a function of lattice constant, and of some other properties, have been made for metallic Be by a self-consistent field method. The theoretical values of binding energy, lattice constant and compressibility, agree reasonably well with experiment. The calculated work function, however, could be made to coincide with the experimental value only by assuming a surface double layer of over 5 V. This suggests a very large deviation of the exchange energy from the value for completely free electrons. An investigation of the behaviour of the exchange energy yields an expression for the deviation from the free electron value which is valid for low electron densities, but not for those which occur in Be. The distribution of the electronic states in energy is found to be of the sort needed to account for the diamagnetism of Be. It is shown that a complicated procedure is necessary to obtain quantitative results when a Hartree ion core field is used and that construction of an empirical field is preferable; it is necessary to calculate directly the energies of states near the Fermi surface. This was done by the "orthogonalized plane wave" method, which is shown by tests to be capable of fairly high accuracy, though laborious. This method suggests a simple qualitative way of understanding a number of features of the electronic energy spectrum of a metal and its manner of variation with lattice constant. Incidental results include a proof that the interaction of the $1s$ shells is entirely negligible, and a calculation of the electrostatic interaction energy of the ions as a function of the c/a ratio. AUTHORS.

2847. Magnetic moments of odd nuclei. H. MARGENAU AND E. WIGNER. *Phys. Rev.*, **58,** *pp.* 103–110, *July* 15, 1940.—To understand the grouping of the nuclear magnetic moments a generalization of Schmidt's single-particle model is considered. In the first approximation the ground state of an odd nucleus is taken to be a doublet state with definite partition quantum numbers but involving both possible values of the azimuthal quantum number L. Only very general assumptions are made concerning the detailed composition of the wave function. On this basis the orbital part of the magnetic moment turns out to be essentially that following from the liquid drop model; the spin part is identical with that of Schmidt. The deviations from the magnetic moments thus obtained, which arise from the admixture of states with higher partition quantum numbers to the original wave function, are calculated. The result is that the magnetic moment is not greatly changed even when the partition quantum numbers are no longer sharp. The present model fails to explain the near equality of the moments of isotopes which has been found experimentally. AUTHORS.

***2848. Scattering of 50-kV electrons by aluminium.** C. T. CHASE AND R. T. COX. *Phys. Rev.*, **58,** *pp.* 243–251, *Aug.* 1, 1940.—Apparatus is described for scattering electrons with thin foils and measuring the intensity of scattering in a narrow pencil making any angle from 30° to 120° with the direction of incidence. Electrons with energies below 95% of the energy on incidence are excluded by a retarding voltage. The theory of nearly single scattering is discussed, and a general expression is found for the error introduced by slight plural scattering. In the case of Rutherford scattering this expression gives for the fractional error the value $\epsilon^2\{\csc^2(\theta/2) - \frac{1}{2}\}$ where θ is the angle at which scattering is measured and ϵ^2 is the mean square deflection of particles traversing in the foil the same length of path as those scattered at the angle θ. The relation of this result to Wentzel's criterion is shown. Electrons accelerated by 50 kV were scattered by thin composite foils of Al on collodion. A difference was found, though not explained, between the intensities of scattering at 90° on the two sides of the foil, which was inclined at 45° to the direction of incidence. With allowance made for this asymmetry in comparing the scattering at angles above and below 90° relative intensities at angles from 30° to 120° were within 5% of those predicted by Mott. Comparison of the observed and predicted absolute intensities of the scattering from Al was subject to an uncertainty of about 20%, prinçipally in the determination of the thickness of the Al film. Within this uncertainty the observation agreed with the prediction. If the actual scattering differs from the predicted, it appears from these observations to be rather less than greater.

2849. Angular distribution of fast neutrons scattered by the atoms. Part III. T. WAKATUKI. *Phys. Math. Soc. Japan, Proc.*, **22,** *pp.* 430–441, *June*, 1940.—The angular distribution of fast neutrons scattered by proton, C, Al, Fe, Sn, Pb, was measured for both D-D and Li-D neutrons. The differential scattering cross-section for 3 eMV neutrons was found to have a maximum at about 20° for most elements except proton. In the scattering of Li-D neutrons this maximum does not appear. The data on the scattering of neutrons by protons which were obtained in the previous work [Abstract 4145 (1939)] are discussed with the addition of new data. The scattering cross-section for C-D neutrons measured by Amaldi and others were utilized in these discussions. A very marked anisotropy is necessary to account for the experimental results. AUTHOR.

2850. Pair creation of mesons by γ-rays and the "Bremsstrahlung" of mesons in the nuclear field. M. KOBAYASI AND R. UTIYAMA. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 965, *pp.* 221–225, *April*, 1940.—The cross-section for the creation of a pair of positive and negative mesons by a photon of very high energy on collision with an atomic nucleus was calculated by the method of impact parameters. Calculation is also made of the scattering of high-energy photons by free mesons and of the generation of photons by meson impact on nuclei. The results show that the occurrence of the processes increases rapidly with increasing energy of the incident particles. Criteria limiting the validity of the formulae are examined and lower limits of application are estimated. Full details are reserved for a later paper. F. C. C.

2851. Distribution in angle of protons from the deuteron-deuteron reaction. R. D. HUNTOON, A. ELLETT, D. S. BAYLEY AND J. A. VAN ALLEN. *Phys. Rev.*, **58,** *pp.* 97–102, *July* 15, 1940.—The distribution in angle of the protons from the deuteron-deuteron reaction has been measured with a gas target over a range of bombarding energy from 60 to 390 ekV. The results are representable by $N(\theta) = 1 + A \cos^2 \theta$ in which θ is the angle which the proton's velocity makes with the direction of the deuteron beam as measured in the centre-of-mass co-ordinate system and $N(\theta)$ is the number observed per unit solid angle at θ. The value of A is found to be markedly dependent on bombarding energy. AUTHORS.

***2852. Accurate measurement of the energy released in the disintegration of Li^6 by protons.** G. J. PERLOW. *Phys. Rev.*, **58,** *pp.* 218–225, *Aug.* 1, 1940.—The energy release in the reaction $Li^6(p,\alpha)He^3$ has been determined by a comparison of the He^4 range with that of the α-particles from $Be^9(p,\alpha)Li^6$. The energy of the latter reaction is accurately known from electrostatic deflection measurements. The determination was carried out in a small absorption cell and ionization chamber of variable air pressure, both being at the same pressure. The device had high dispersion, 1 mm. of range corresponding to about 13 cm. Hg. Calibration of the cell was carried out by a method which utilized this high dispersion. The Q value for the reaction was found to be **3·945 ± 0·06 eMV** as compared to the previously accepted value due to Neuert of **3·72 ± 0·08.** With the new Q value, H^3 is found to be unstable against β-decay by either 0·19 ± 0·09 or 0·10 ± 0·1 eMV depending on whether Bainbridge's or Aston's value for the D-He bracket is used. The mass of He^3 is found to be **3·016 88 ± 0·000 11 mass units.** AUTHOR.

2853. Collision of mesotrons with electrons. S. TOMONAGA. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 976, *pp.* 399–413, *June,* 1940. *In German.*—This is a theoretical paper in which the method of collision parameters is developed, taking into consideration the influence of the value assigned to the mesotron spin. The method is applied to the problem of ionization and the production of electron pairs by a mesotron. E. E. W.

2854. Reactions of high energy atoms produced by slow neutron capture. W. F. LIBBY. *Am. Chem. Soc., J.*, **62,** *pp.* 1930–1943, *Aug.*, 1940.—The neutron capture recoils for MnO_4' appear to cause one or two O''-ions to be ejected; the unstable + 7 ions so formed are hydrated rapidly by OH′ to form MnO_4' again in alkaline solution, while in neutral or dilute acid solution they oxidize H_2O and in strong acid some of them appear to interchange the O''-ion with MnO_4'. For solid $KMnO_4$ at room temperature about 30% of the activity is permanently reduced and about 30% retained as KMn^*O_4, and the residual 40% is trapped in the crystal as the + 7 ions; at liquid air temperature the percentage retained in the crystal as KMn^*O_4 is about 50%. A rapid interchange of a 3*d* electron occurs between MnO_4''- and MnO_4'-ions; for + 5 phosphorus molecules and ions the recoils seem to eject oxidized oxygen leaving + 3 phosphorus about half of the time. Both + 3 and + 5 arsenic appear to expel − 2 divalent oxygen; all the halate ions appear to be reduced by expulsion of − 1 or atomic oxygen, and the halate ions interchange with the molecular halogens in acid solution, the rates increasing from Cl to I. J. K.

See also Abstracts 2723, 2809, 2842, 2867 and
1811B. Rectilinear electron flow in beams. J. R. Pierce.

MAGNETISM AND ELECTROMAGNETISM.

2855. Note on the effect of pressure on the Curie Point of Fe-Ni alloys. J. C. Slater. *Phys. Rev.*, **58**, *pp.* 54–56, *July* 1, 1940.—By applying Clapeyron's equation an estimate is made of the increase of the Curie point of Ni with pressure which comes out of the order of magnitude of 5×10^{-5} deg. per atm. For Fe-Ni alloys the increase of Curie point with pressure would become less as more Fe is added, becoming zero with something like 70% of Ni, and for the alloys containing more Fe the Curie point would decrease with pressure. These magnitudes are such that it seems unlikely that pressures existing in the Fe-Ni core of the earth would raise the Curie point of the material enough so that it could be ferromagnetic at the temperatures existing inside the earth. This makes any ferromagnetic explanation of the magnetism of the earth most implausible.
Author.

2856. Diamagnetism and the hydrogen bond. W. R. Angus and W. K. Hill. *Faraday Soc., Trans.*, **36**, *pp.* 923–925; *Disc.*, 925–928, *Sept.*, 1940.—Preliminary results on a general investigation of diamagnetism and hydrogen bonding are discussed by reference to measurements on different concentrations of benzoic and hydroxybenzoic acids in various solvents of different proton-attracting powers. Susceptibilities of solutes are derived from the mixture law, and it would appear that when formation of a hydrogen bond simultaneously involves ring formation the susceptibility of the hydrogen-bonded structure is considerably less than the anticipated additive value and diminishes as the concentration of solute increases. On the other hand, when an " open " addition compound is formed by intermolecular hydrogen bonding between solute and solvent the susceptibility of the solute increases with solute concentration.
Authors.

MEDICAL RADIOLOGY AND ELECTROLOGY.

2857. Effect of X-rays on cells cultivated in vitro. I. Lasnitzki. *Brit. J. of Radiology*, **13**, *pp.* 279–284, *Aug.*, 1940.—Previous work on the effects of X-rays on cell cultures has been largely confined to studies of alterations of mitotic activity and phase relationships. In the present series cultures were irradiated to determine what degenerative changes, if any, followed the mitotic effects already observed. Material from the choroid and sclerotic of chick embryos was cultured by the well established methods and the experimental samples received an X-ray dose of 96·7 r. The irradiation causes a fall in mitosis, followed by an attempt at recovery, together with the appearance of degenerate cells. The results resemble those obtained in experiments *in vivo*, and it is concluded that the effects of radiation at these dosages is independent of any effect on blood circulation.
J. E. R.

2858. A new organic Th compound for X-ray diagnostic purposes. F. R. Greenbaum and A. F. Peters. *Radiology*, **35**, *pp.* 45–50, *July*, 1940.—The obvious advantages of suspensions of ThO_2 as a radio-opaque medium are discounted by its radioactivity and by the fact that it is retained cumulatively in the body. The preparation of a water-soluble Th compound namely NaTh tartrate, is described. The effect of the radioactivity of this compound is reduced by dissolving in solutions of sugars or gelatine. The radio-opacity has been investigated and the films claimed to be superior to those obtained with $BaSO_4$. Experiments on rabbits indicate that the compound is non-toxic, and is rapidly and completely eliminated. Rabbits thus treated showed no changes in bone or tissue. J. E. R.

2859. Optimum densities of radiographs. G. E. Bell and E. E. Smith. *Brit. J. of Radiology*, **13,** *pp.* 285–288, *Aug.*, 1940.—The writers have examined theoretically and experimentally some of the photographic factors which affect the detectability of a small void or excrescence in the radiograph of an object of uniform thickness. It is shown that the actual difference in blackening between the defect and the background increases with increasing density, at least up to a density of 5. The blackening difference which can be appreciated by the eye is, however, a function of the brightness of the surface examined. The combined effect of photographic sensitivity and eye sensitivity results in a range of densities for which the resolution is greatest. This range of optimum densities extends roughly from 1 to 2. The theoretical conclusions have been confirmed experimentally. Radiographs of a paper step wedge were examined by a number of independent observers, the mean results of the observations agreeing well with the theoretical predictions. J. E. R.

2860. Location and extraction of radio-opaque objects by means of "light-compress." C. Chaussé. *Brit. J. of Radiology*, **13,** *pp.* 257–266, *Aug.*, 1940.—Radiographic methods of location of foreign bodies are divided into 2 sections, anatomical and geometrical. For anatomical location a modification of the usual stereoscopic methods is described, using a double tube shift, and in some cases 3 exposures on 1 film. In this way a complete analysis of the position of the foreign body with respect to anatomical structures is possible. The method also allows of the use of small films. For geometrical location modifications of the author's "light compasses" are suggested. Radioscopic and radiographic methods of determining the depth and direction of the foreign body are described. A reconstruction of the position of the body in space is obtained, and it is possible to carry on the observations before and during operation. A critical comparison of the "light compasses" and the Hirtz method of location is given. J. E. R.

2861. Percentage depth doses in l.v. X-ray therapy. W. J. Meredith. *Brit. J. of Radiology*, **13,** *pp.* 320–321, *Sept.*, 1940.—The published values of the percentage depth doses for a contact therapy X-ray tube, and those obtained with the special Siemens ionization chamber, are analysed and the large differences between them are shown to be due to soft secondary radiations from the applicator sides and the tube window, being measured to different extents by the different methods of measurement. If the depth doses are expressed as percentages of the dose received at 1 cm. instead of at the surface, the values for each observer are the same, except at the surface. It is therefore suggested, if measurement by a standard instrument in every clinic is not possible, that this method of depth dose statement should be used. Author.

2862. Responses of *drosophila* pupae to X-rays. P. S. Henshaw and I. M. Golomb. *Radiology*, **34,** *pp.* 721–730, *June*, 1940.—This work was carried out partly to determine whether the pupae of *drosophila melanogaster* were more suitable for radiobiological work than the eggs, which have several disadvantages. It was found that the radiosensitivity of the pupae was substantially constant for the first 18 to 20 hrs., the criterion being emergence from the pupae stage and various states of development in that stage. In normal development 3 phases were found: 0 to 24 hrs. involving the destruction of larval organs, 24–48 hrs. of relative quiescence and 48–96 hrs. of active organogenesis. The various phases are associated with different rates of oxygen uptake, a positive correlation between oxygen uptake and development was found but none between either of these and radiosensitivity. It is concluded that *drosophila* pupae are satisfactory as test material on the grounds of supply, size, resistance to drying, constancy of susceptibility, relatively high sensitivity and accuracy of end-results. G. E. B.

2863. The measurement of dose in Röntgen therapy. E. H. QUIMBY AND G. C. LAURENCE. *Radiology*, **35**, *pp*. 138–159, *Aug*., 1940.—Technical Bulletin No. 1 of the Radiological Society of N. America Standardization Committee.

2864. Design of a 4 gm. radium bomb. A. H. WARNER AND R. H. NEIL. *Am. J. of Roentgenology and Radium Therapy*, **44**, *pp*. 117–121, *July*, 1940.—In the bomb constructed by the authors mercury and steel were utilized for the container and the protective value in respect of 4 gm. of radium is theoretically discussed. When being adjusted for distances from 1 to 15 cm. from the patient the actual radium container is at the centre of the bomb. B. J. L.

2865. Nuclear physics and therapy ; preliminary report on a new method for the treatment of leukemia and polycythemia. J. H. LAWRENCE. *Radiology*, **35**, *pp*. 51–60, *July*, 1940.—Up to the present the artificially radioactive isotopes which have resulted from recent advances in the study of nuclear physics have only been used biologically as " tracers " or " tagged atoms " in following physiological processes. As increasing amounts of these materials become available their use for the treatment of disease becomes possible, but is hardly justifiable at present unless radium or radon are not available. The introduction into the body of a radioactive substance of comparatively short life, either orally or by injection, opens up a new field of therapy. J. E. R.

***2866. Mechanical construction of a radium beam unit.** F. HAPPEY. *Journ. Sci. Instruments*, **17**, *pp*. 221–225, *Sept*., 1940.—A description is given of the details of construction and the method of operation of the radium beam unit which has been installed at the Radium Centre in Sheffield. The bomb is a mass unit capable of carrying a maximum content of 6·2 gm. of radium in a light, flexible shuttle. This is transferred pneumatically from the safe to the bomb and vice versa. An automatic signalling gear and clock is incorporated in the apparatus. The bomb may be raised vertically by means of an electric motor and can rotate round vertical and horizontal axes. A vertical traverse of 3 ft. is possible for the bomb and an overwind mechanism is brought into action in the highest and lowest positions of the bomb head. AUTHOR.

PHOTO-ELECTRICITY.

2867. X-ray electrons expelled from metals by silver $K\alpha_1$ radiations. C. J. B. CLEWS AND H. R. ROBINSON. *Roy. Soc., Proc. A.*, **176**, *pp*. 28–33, *Aug*. 28, 1940.—The energies of the X-ray electrons expelled from targets, of Au, Pt, Ag and Cu, by silver $K\alpha_1$ rays have been measured in the magnetic spectrograph. The results have been combined with those of earlier measurements, and they yield a value for Planck's constant of $6{\cdot}62_9 \times 10^{-27}$ erg sec. [See Abstract 2304 (1935).] AUTHORS.

***2868. Photocell multiplier tubes.** C. C. LARSON AND H. SALINGER. *Rev. Sci. Instruments,* **11,** *pp.* 226–229, *July,* 1940.—Structural and performance data on a Cs–Cs_2O–Ag type of photo-electric cell whose current output is amplified by an integral 6- or 11-stage electron multiplier are given. AUTHORS.

2869. The action of electrons and X-rays on photographic emulsions. A. CHARLESBY. *Phys. Soc., Proc.,* **52,** *pp.* 657–700, *Sept.,* 1940.—The measurement of electron densities by means of their photographic effect is discussed, and the results of many past investigations on the photographic action of light photons, X-ray photons and electrons, are summarized. Attention is drawn to many points of similarity between high-velocity electrons and X-ray photons, and between low-velocity electrons and light photons. The effect of a gradual increase in the energy of the incident particle on the shape of the blackening curve is also discussed. A theory based on an exponential decrease in the effect of the electrons due to absorption in the emulsion is advanced. The resultant formula is found to depend in a simple fashion on the grain properties of the emulsion and on the absorption of the beam within it. An extension to variation with grain size is given, and the effect of varying absorption on the shape of the blackening curve is investigated. Previous formulae are compared with the new one, many approximations being found to be similar in nature. Comparison of the formula with experimental results obtained by previous investigators and by the writer allow many of the grain properties of the emulsion to be correctly predicted, as well as the shape of the blackening curve, the range in the emulsion, etc. In particular, the apparent independence of the shape of the characteristic curve for X-rays of the wavelength is deduced, and it proves possible to account for observed variations. The quantitative agreement obtained in many cases tends to show the general correctness of the theory. Some possible uses of the theory are appended. AUTHOR.

***2870. Simple apparatus for detecting the pyro-electric effect in crystals.** R. G. WOOD AND C. H. MCCALE. *Journ. Sci. Instruments,* **17,** *pp.* 225–226, *Sept.,* 1940.—The construction and use of a simple apparatus for detecting the pyro-electric effect in crystals is described. The application of the apparatus in X-ray crystallography is briefly discussed and some typical results are given. AUTHORS.

PIEZO-ELECTRICITY.

See Abstract 2838.